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POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN - ILLINOIS, INDIANA, MICHIGAN AND WISCONSIN. PROCEEDINGS OF CONFERENCE, SECOND SESSION, HELD AT CHICAGO, ILLINOIS ON FEBRUARY 25, 1969. VOLUME 2

Federal Water Pollution Control Administration
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PROCEEDINGS

Volume 2

ILLINOIS
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Second Session
February 25, 1969
Chicago, Illinois

CONFERENCE

Pollution of Lake Michigan and its Tributary Basin, Illinois, Indiana, Michigan, and Wisconsin

U.S. Department of the Interior • Federal Water Pollution Control Administration

SECOND SESSION

OF THE

CONFERENCE

ON THE MATTER OF POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN

held in

Chicago, Illinois

February 25, 1969

TRANSCRIPT OF PROCEEDINGS

VOLUME II

AFTERNOON SESSION

(2 o'clock p.m.)

MR. STEIN: Let's reconvene.

Calling on Wisconsin, Mr. Voigt.

STATEMENT BY L. P. VOIGT
SECRETARY, WISCONSIN DEPARTMENT OF NATURAL RESOURCES
MADISON, WISCONSIN

MR. VOIGT: Chairman Stein, fellow Conferees, and ladies and gentlemen.

With the Chairman's indulgence, after a very ample lunch, I feel more comfortable standing up as compared with Mr. Klassen and some of the other States that reported previously.

I am contemplating making just a brief overview of some of the happenings in Wisconsin since the Conference met last, and for the specific response to the questions and the recommendations, I will call on Tom Frangos and Pat Thropnickel from our department.

But the year that has elapsed since this Conference last met has been an eventful one in Wisconsin.

and I thought you might be interested in some of the happenings that have a direct bearing on this particular Conference and on clean water and a quality environment. With the dedication of our Governor Knowles, our National Resources Board, and particularly our dedicated department, I think we have made progress and I would like to call your attention to it.

One of the things that has been a point of marked interest was the creation of our Wisconsin Department of Natural Resources. This Department was ordered by the 1967 Legislature, known as the Kellett Law, Chapter 75, Wisconsin Laws of 1967. It created a uniform department, including the pollution activities of the former Department of Resource Development and the resource management functions of the former Conservation Department with which I was associated.

Although this was accomplished only last July 1st, the advantages are becoming more apparent every week. For example, we now have fish management researchers helping field engineers pin down the point source of the dieldrin problem, we have conservation wardens being backed up by sanitary engineers in gathering fish kill evidence and we also have our people from all the departments, the scientists working on water diversion cases and other things of concern for the total environment. The benefits add up to a greatly improved program support and management service to which this enlarged department can contribute.

Speaking on several of the other points that might be of interest that aren't related to the specific recommendations, I would like to mention the subject of pesticide pollution. One of the significant findings of the Conferees when they last met was that pesticides, particularly the persistent hydrocarbons, are a form of interstate pollution. Our department has long had a concern in this area, so much so that several years ago I banned the use of DDT on all our department-controlled and -managed lands and stepped up reserach on the impact of pesticides on the aquatic environment. These studies included two reports which we issued in the last six months and they have done much to promote an understanding of the cumulative effect of our pesticides on fish and the birds and animals which feed on them.

On last July 31st our Board Chairman and myself joined in signing a joint statement of agreement with all the Lake Michigan Basin States directed at the development of a common policy for the protection of the lake from economic poisons.

Speaking to the point of the implementation of water quality standards, our Wisconsin interstate standards were approved by the Secretary of the Interior a little over a year ago. Since that time we have extended these standards to all of our intrastate waters. These standards generally require secondary treatment of sanitary sewage and the equivalent in the treatment of industrial wastes. And it now is our policy on a Statewide basis to require year-round disinfection of effluent.

In implementing these standards, our department issued 266 pollution abatement orders in 1968, including 150 in the Lake Michigan drainage basin. We also conducted several drainage basin surveys during the year, five of them on the Oconto, Peshtigo, Manitowoc, Menominee and Milwaukee Rivers within the lake basin.

The followups on consultation and

inspection by our field engineers have been intensified in this year's period.

In the field of certification of operators, on January 1, 1969, our Wisconsin law became effective which requires that municipal and industrial waste treatment plants employ certified operators. To accomplish this, an intensive Statewide training program was setablished by the department during 1968 to give every potential operator an opportunity to qualify for certification. The response and success of the examinations were most gratifying to the department.

In the related field of shore land and flood plain zoning, one of the basic features of our basic law, the Wisconsin Water Resources Act, was the requirement that counties zone all shore lands in unincorporated areas to protect against unwise development. All of our counties have initiated steps to comply with this section of our statutes, and a dozen counties now have had their zoning, sanitary code and subdivision regulations fully approved by our department.

In the field of solid waste disposal, location and operation of dumps and sanitary landfills have a direct impact on water quality. In a half a dozen cases the department has issued orders directing municipalities to abandon sites subject to periodic flooding. Under a new State law, our department has drafted Solid Waste Disposal Standards which, when approved by the Natural Resources Board, will regulate the location and operation of disposal sites through a required State licensing procedure. Sites must be selected which by natural or by sealing minimize leaching to either ground or surface waters.

With regard to research, in cooperation with State universities, research into water resource programs is being pushed on several fronts. Subject areas include pesticides, nutrient removal techniques, coliform bacteria, spent sulfite liquors, aquatic nuisance control, and adaptation of computers to flood plain delineation. It might be of interest to note that we have contracted for a mathematical model of the Fox River. Outside of the department, Wisconsin research projects include joint municipal-industrial waste treatment, application of reverse osmosis techniques to the pulp and paper industry, and the use of holding tanks or basins to minimize the by-passing which can occur in combined sewer systems.

In the field of financial assistance, things are improving in Wisconsin too, and although our construction is at an all-time high in Wisconsin, we,as many other States, are awaiting promised Federal and State funds. The underfunding of the Federal grant program, coupled with an increase in grant eligibility to 50 percent of project cost, would enforce the cutback in our construction pace.

As a suggested remedy, our Governor established an Outdoor Recreation Act Program Task Force, which recommended a joint recreational bonding and pollution abatement bonding program which we hope will come up for referendum in our State on April 1st. If this advisory referendum is adopted, the Legislature would have this advisory guidance to authorize our department by a bill, which has also been drafted, to provide for direct State grants and Federal aid advance payments to municipalities, guaranteeing at least 55 percent of the capital cost on these approved projects. We estimate that this program, if it passes, would stimulate at least

280 million dollars in pollution abatement construction in the next 10 years.

Now, this is just an overview of our efforts in environmental protection, particularly those that have specific reference to the Lake Michigan Basin. I am going to call on Tom Frangos to make the specific response on our progress under the recommendations of the Conference.

(The following is the document submitted by Mr. Voigt:)

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
STATEMENT OF SECRETARY L. P. VOIGT
LAKE MICHIGAN ENFORCEMENT CONFERENCE
SECOND SESSION - FEBRUARY 25, 1969

A year has elapsed since the initial sessions of the Lake Michigan Enforcement Conference. It has been an eventful year and, in many ways, a fruitful one. While the potential threat to the quality of Lake Michigan has not greatly diminished, awareness of that threat has been intensified. The progress reports and action plans under review here give us cause for at least cautious optimism.

Many of the things which have occurred in Wisconsin this past year bear on the future of Lake Michigan as well as the other vast water resources of our State. They reflect the dedication of Governor Knowles, the Wisconsin Natural Resources Board, and the staff of our Department to the total cause of clean waters and a quality environment.

To the extent that they have a bearing on these proceedings, I would like to summarize these achievements:

1. Creation of the Wisconsin Department of Natural Resources

Reorganization of all State agencies was ordered by the 1967 Wisconsin Legislature. This was aimed at creating a more efficient and responsible State government, and at strengthening such programs as the protection of Wisconsin's natural resources.

To this end, the pollution enforcement activities of the former Department of Resource Development were merged with the resource management functions of the former Conservation Department. Although this was accomplished only last July 1, the advantages are becoming more apparent each week. Fish management researchers have helped field engineers pin down the point source of a dieldrin problem; conservation wardens have been backed up by sanitary engineers in gathering fish-kill evidence; ecological concepts involved in water diversion cases are subject to earlier consideration.

The benefits include the program support and management services which an enlarged department can also supply.

2. Pesticide Pollution

One of the significant findings of the Conferees was that pesticides, particularly the persistent hydrocarbons, are a form of interstate pollution. Our Department has long had a concern in this area. It led us to ban the use of DDT on all Department-controlled lands, and to step up reserach on the impact of pesticides on the aquatic environment. These studies, including two reports issued in the past six months, have done much to promote an understanding of the cumulative effect of "hard" pesticides on fish and the birds and animals which feed on them.

Last July 31 our Board Chairman and I joined in signing a "Joint Statement of Agreement by Lake Michigan Basin States" directed at developing a common policy for protection of the lake from economic poisons.

3. Implementation of Water Quality Standards

Wisconsin's Interstate Water Quality Standards were approved by the Secretary of the Interior a little over a year ago. Since that time, we have applied the same standards to all intrastate waters.

These standards generally require secondary treatment of sanitary sewage and the equivalent in treatment of industrial wastes. It is now our policy, Statewide, to require year-round disinfection of effluent.

In implementing these standards, the Department issued 266 pollution abatement orders in 1968, including 150 in the Lake Michigan drainage basin. Seven drainage basin surveys were conducted during the year, five of them on the Oconto, Peshtigo, Manitowoc, Menominee and Milwaukee Rivers within the lake basin.

Follow-through efforts, including

consultation and inspection by field engineers, have been intensified.

4. Certification of Operators

As of January 1, 1969, Wisconsin law requires that municipal and industrial waste treatment plants employ certified operators. An intensive Statewide training program was established by the Department during 1968 to give every potential operator an opportunity to qualify for certification. The response and the ratio of success on the examinations were gratifying.

5. Shoreland and Flood Plain Zoning

A basic feature of the Wisconsin Water Resources Act was the requirement that counties zone all shorelands in unincorporated areas to protect against unwise development. All counties have initiated steps to comply with this section of the statutes, and a dozen of them have had their zoning, sanitary code and subdivision regulations fully approved by our Department.

6. Solid Waste Disposal

Location and operation of dumps and sanitary landfills can have a direct impact on water quality. In a half-dozen cases, the Department has issued orders directing municipalities to abandon sites subject to periodic flooding. Under a new State law, our Department has drafted Solid Waste Disposal Standards which, when approved by the Natural Resources Board, will regulate the location and operation of disposal sites through a State licensing procedure. Sites must be selected which naturally, or through sealing, minimize leaching to either ground or surface waters.

7. Research

In cooperation with State universities, research into water resource programs is being pushed on several fronts. Subject areas include pesticides, nutrient removal techniques, coliform bacteria, spent sulfite liquors, aquatic nuisance control, and adaptation of computers to flood plain delineation. We have also contracted for a mathematical model of the Fox River. Outside of the Department, Wisconsin research projects include joint municipal-industrial waste treatment, application of reverse osmosis techniques to the pulp and paper industry, and use of holding tanks or basins to minimize the by-passing which can occur in combined sewer systems.

8. Financial Assistance

Although the construction of municipal sewage treatment facilities is at an all-time high in Wisconsin, many projects are awaiting promised Federal and State funds. Underfunding of the Federal grant program, coupled with an increase in grant eligibility to 50 percent of project cost, could force a cutback in this construction pace.

To overcome this, the Governor's ORAP Task Force has attached a pollution abatement bonding program to a pending recreational bonding measure. If adopted by the Legislature, this would enable our Department to provide direct State grants and Federal fund advances to Wisconsin municipalities, guaranteeing at least 55 percent of the capital cost of these vital projects. This program could stimulate at least $280 million in pollution abatement construction in the next 10 years.

This is at best a partial catalogue of Wisconsin's current efforts in environmental protection, but it serves to illustrate the sincerity with which we approach this challenge.

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MR. VOIGT: I would like to add my personal thanks for being invited here as a Conferee. It is my first time and I am greatly impressed, Chairman Stein, and I think I will enjoy working with this group.

I also would like to add the invitation that perhaps at one of our resumed sessions you would accept the invitation of the State of Wisconsin to hold one of your resumed sessions in either Madison or Milwaukee, because we would like to have you come.

Thank you very much.

MR. STEIN: Thank you.

Why don't you wait there. Milwaukee is in the basin. I am not sure, Madison isn't. We might be there.

Are there any questions or comments?

Let me make this one. I am really very gratified by your statement. You had a couple of points there. One of these is the first I have heard from a State. Now, listen to this. Mr. Voigt said:

"Although the construction of municipal sewage treatment facilities is at an all-time high in

Wisconsin"--

MR. VOIGT: That is right.

MR. STEIN: And I welcome that, because we have heard expressions that the grant program in the past has held it back in Wisconsin. I have never seen that. But--

MR. VOIGT: This is a case of us rolling up our sleeves and getting to work.

MR. STEIN: Sure, I know.

MR. VOIGT: We don't like the Federal underfunding, don't misconstrue the statement to mean that.

MR. STEIN: I am not. I am just reading this. You say it is at an all-time high, and I love it.

You say, "many projects are awaiting promised Federal and State funds." This is the first State I have ever heard say that, "Federal and State funds." Generally they drop that "State" out and they just say "promised Federal funds."

(Laughter.)

MR. VOIGT: We are willing to pull our share of the load.

MR. STEIN: I know, but you are the first one who ever said it in a Conference. (Laughter.) Bless you.

Now I have a question, and this is for clarification. On your point 2, on pesticide pollution, you talked about directing a common policy for the protection of the lake from economic poisons. I am interested in that adjective. What do you mean by economic poisons?

MR. VOIGT: We are thinking of any poisons that are used commercially.

MR. STEIN: You know, I don't want to take the name of my namesake in vain, but it seems to me a poison is a poison is a poison. What is this economic poison?

(Laughter.)

MR. VOIGT: We are thinking of commercial applications, is what we are referring to there.

MR. STEIN: Right.

MR. VOIGT: Perhaps the term is a misnomer, but I hope that clarifies it for you.

MR. STEIN: Right. Thank you, it does.

MR. VOIGT: Tom, do you want to lead off?

STATEMENT BY THOMAS G. FRANGOS
DIRECTOR, BUREAU OF WATER RESOURCES
WISCONSIN DEPARTMENT OF NATURAL RESOURCES
MADISON, WISCONSIN

MR. FRANGOS: Mr. Chairman, fellow Conferees, ladies and gentlemen.

One of the things that we in Wisconsin never totally get used to is the fact that whenever we appear at one of these interstate programs with other States we always end up being the last one on the roster, unless we happen to be participating with the State of Wyoming, and that doesn't happen too often. So much of what you heard we will be repeating here in our presentation, and I will ask your indulgence and we will try to go through this as rapidly as possible.

The following is a summary report that outlines the response of the Wisconsin Department of Natural Resources to the recommendations of the first session of the Lake Michigan Enforcement Conference and details actions that have been taken in Wisconsin to achieve compliance with the several recommendations.

This report is deliberately brief so that the Conference may proceed with the business before the second session. However, we felt that it would be useful to expand on some of the materials previously submitted to the Conference and to summarize the status of the Wisconsin abatement program. Additionally, we have several proposals to make to the Conference in the nature of clarification of the interpretation of several of the recommendations of the first session of the Conference.

The following comments have been itemized to correspond with the recommendation numbers as they appear in the Summary of Conference (first session).

Recommendation #1 - General Waste Treatment Requirements

The interstate water quality standards for Lake Michigan that have been established and approved by the Secretary of Interior provide for secondary treatment for all municipal wastes. Implementation of this requirement will be substantially accomplished by December 1972.

The requirement that "...waste treatment is to be provided by all municipalities to achieve at least 80 percent reduction of total phosphorus..." if literally interpreted and applied is particularly inflexible and has produced administrative problems, especially with our smaller communities. Upon review of the Wisconsin phosphorus contribution from municipal sources, it seems to us that the objectives of this recommendation could better be met by accounting for the total phosphorus load to the drainage basin against which a reduction of 80 percent could be made. An analysis of population distribution of communities within the Wisconsin portion of the Lake Michigan drainage basin shows that 11 out of 177 listed municipal sources account for 83 percent of the population in the basin. A total of 15 communities account for almost 86 percent of the population while 33 communities account for 92 percent of the population. There follows a table which indicates the population distribution.

In arriving at conclusions as to the application of phosphorus removal requirements, the following items were seriously and extensively reviewed and considered:

1. A review of research activities and information available from other investigations over the

past twelve months leads us to conclude that it is very likely that phosphrous removals considerably in excess of 80 percent can be achieved at large, well operated sewage treatment plants. On the other hand, it is unrealistic to expect to obtain this same kind of closely supervised operation that present technology requires for high efficiencies of smaller facilities.

2. Recent surveys of sewage treatment plant operations throughout the State indicate that, on an average, phosphorus reductions obtained by conventional treatment plants appear to be in the 20-40 percent range.

3. The Wisconsin Department of Natural Resources is presently considering the issuance of a Statewide policy to cover phosphate removal at municipal treatment plants. This policy would take into account eutrophication problems on our inland waters. The current proposal would require phosphorus removal at those facilities where the receiving water body has severe problems of overfertilization. It is hoped that the newly proposed algal growth potential test presently being developed by the Joint Industry-Government Task Force will provide all regulatory agencies with a tool that will permit assessment

of benefits that can be achieved by reducing phosphorus contributions from point source discharges. As the policy requirements are implemented, it can be expected that a number of smaller communities will need to remove phosphorus.

In view of the population distribution in Wisconsin and in light of the various factors presently at work as described above, it is suggested that the Conference consider and adopt an approach that considers phosphorus reduction requirements against the total phosphorus load in each State that is tributary to Lake Michigan. This approach would be comparable to that taken in the Lake Erie Enforcement Conference.

If this approach is acceptable to the Conference, the phosphorus reduction requirement will be applied to all Wisconsin municipalities with a population of 5,000 or greater. There is a listing of these municipalities in Attachment A. In consideration of removals achieved at these 33 communities, reductions obtained at conventional treatment plants in smaller communities and the application of a general Statewide policy, it is felt that the Wisconsin phosphorus reduction will substantially meet the objectives of the Enforcement Conference by December 1972.

And I might add that we came to this recommendation without consultation with our friends in Indiana and we were glad to see that they were suggesting something along this line today.

Recommendations Nos. 2 and 8 deal with industrial wastes. I think the statement speaks for itself and I will not read that.

Recommendation No. 3, abatement schedules.

In accordance with the recommendations of the Lake Michigan Enforcement Conference, Wisconsin's Division of Environmental Protection has prepared and submitted to all Conferees two lists of municipalities and industries discharging wastewater to the Lake Michigan Basin. The first listed the 436 potential waste sources within the basin. The second listed the 111 waste sources within the basin which in our judgment have an effect upon Lake Michigan water quality. The following information was given for each waste source: Location of the facility by river basin and receiving stream, type of waste, flow, population served, existing treatment, required additional treatment, and the estimated date of completion for additional requirements.

It should be noted that the list does not specifically comment on needs for controlling pollution from combined sources. This is a blanket requirement for all communities where this problem exists in accordance with Recommendation No. 7. This information can be supplied through the Conferees.

The listing of phosphorus removal requirements was made on the basis of "all" municipalities. The schedule will need to be amended on the basis of acceptance by the Conferees of the proposed approach for reducing phosphorus discharge in the Lake Michigan drainage basin.

Attachment B to this report contains a summary of the status of industrial waste sources in the basin with a brief discussion of progress. It also contains errata that should be incorporated into the history of Wisconsin wastewater sources in Lake Michigan drainage basin affecting Lake Michigan water quality.

Subsequent to receipt of the Summary of Conference, the Wisconsin Department of Natural Resources issued orders and letters to all municipalities citing the need for compliance with State water quality standards and the Enforcement Conference recommendations. Orders were issued in those instances where public hearings had been conducted immediately following the convening of the Lake Michigan Conference. Letters were sent to those dischargers located in sub-basins for which public hearings had not been held. On the basis of drainage basin surveys conducted this past year, public hearings will be conducted in the next few months in much of the area in the Lake Michigan Basin. Orders issued subsequent to those hearings will legally reinforce requirements now covered by letter issued by the Department.

Because of the interest previously expressed at the first session over poor water quality conditions of the Fox River between Lake Winnebago and Green Bay, a brief discussion of actions under way is presented at this point. This area was the subject of a public hearing some 11 months ago and orders were issued against all municipalities and industries that are required to meet State water quality standards and the applicability requirements of the Lake Michigan Enforcement Conference.

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Treatment facilities to meet water quality standards that relate to dissolved oxygen, suspended solids and phosphorus removal are to be substantially accomplished by December 1972.

Because of the complex water quality problems in this portion of the Fox River, a number of steps have been taken by municipalities and industries and the Department, all of which are in accord with several of the Lake Michigan Enforcement Conference recommendations.

Four pulp and paper industries and the city of Green Bay have been undertaking a research investigation (partially funded by the Federal Water Pollution Control Administration) to determine the feasibility of joint municipal industrial treatment facilities. Results to date appear promising. A decision by those involved with the research as to whether to proceed to a joint treatment facility is expected by January 1970.

Some 15 industries and several municipalities at the southern end of the Fox River are cooperating in a joint study undertaken by the Fox Valley Council of Governments to determine the feasibility of a joint sewage system at that area of the river. This study is sponsored, in part, by the Department of Housing and Urban Development. A decision on whether to proceed on this proposal is expected by January 1970.

Because of the intensive use of the Fox River, the water quality conditions are complex. In order to more accurately predict river response to anticipated reductions in waste loadings and to assist the Department in administering its water pollution control program, the Department has contracted with a consultant engineering firm to develop a mathematical water quality model of the Fox River. It is expected that the availability of a predictive tool will enable the Department to more precisely assess water quality conditions and to more firmly establish treatment requirements. It should be noted that much of the basic data that is required to develop a mathematical model was provided by the Federal Water Pollution Control Administration as a result of field surveys it had conducted several years ago. The model will be available to the Department by July 1, 1969.

Although timing of the several activities now under **way** is critical, it is still anticipated that required facilities will be constructed and operating by December 1972. In the meantime, the orders issued by the Department require that industries and municipalities proceed immediately with whatever work can be accomplished without prejudice, pending decisions on the studies described above.

Recommendation #4 - Municipal Waste Disinfection

Wisconsin has accepted the Lake Michigan Enforcement Conference recommendation concerning continuous disinfection for all municipal treatment plant effluents. It is Statewide policy that throughout the year all municipal treatment plants must provide continuous disinfection. All municipal sources within the Lake Michigan Basin which do not provide continuous disinfection have received either orders or letters requiring preliminary reports and time schedules for the installation or operation of facilities by May 1969.

Although most of the larger communities will be in compliance with the chlorination deadline, several plants will not have plans approved or facilities installed by May 1969. Additionally, we need to report

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that the Milwaukee Metropolitan Sewage Commission provides chlorination at its new South Shore Plant. However, it will not be providing these facilities at the Jones Island Plant by May 1969. We have a commitment from the Commission to install chlorination facilities and we are presently negotiating a time schedule.

Recommendations Nos. 5 and 14 cover areawide sewerage systems, and I think the comments there speak for themselves. I will point out that in the Milwaukee metropolitan area, the Southeastern Wisconsin Regional Planning Commission has received a grant, again from the FWPCA, to develop a detailed water quality management program for the Milwaukee River watershed. An important element of this study will be the development of alternative institutional arrangements for water quality management.

Concurrently, SEWRPC has also initiated a study to determine the feasibility of developing an areawide sewerage system for the highly urbanized seven-county area in the southeast part of the State.

Recommendation #6 - Bypassing

The major combined sewer systems in Wisconsin have been designed and built with suitable overflow structures which insure the full utilization of the capacity of the intercepting sewers. Action is being taken to minimize bypassing whenever possible. All orders issued by the Department contain requirements for reducing bypassing from combined sewers or where "clear water"problems exist. Flow regulating devices may be effective in an overall program of reducing pollution from combined wastes.

Recommendation #7 - Combined Sewers

Combined sewered areas are being separated in relation to urban renewal projects and whenever reconstruction projects permit such separation. No new combined sewers are being installed; however, structurally unsound existing combined sewers are being replaced in limited instances when it is not possible to separate the tributary sewers.

Techniques for handling combined sewage

other than separation are being investigated. Federal demonstration grants have been obtained by the cities of Chippewa Falls and Milwaukee to investigate such techniques. Chippewa Falls, which is not in the basin, is discharging high stormwater flow to a holding pond where the sewage will be stored until the flow subsides sufficiently to allow the pond contents to be directed to the treatment facility. The city of Milwaukee is installing a tank which will also store combined sewage for pumping to the interceptor sewers when the high flow subsides. This facility will be provided with chlorination equipment to allow primary sedimentation and disinfection of the combined sewage flow prior to discharge to the river when the flow exceeds the capacity of the tank. Provisions are made in both demonstration projects to provide records of flow volumes and treatment provided.

Recommendation #9 - Disinfection of Industrial Wastes

We are in agreement with the recommendation that continuous disinfection be provided for industrial effluents containing pathogens which may have a deleterious effect on persons coming into contact with Lake

Michigan waters. However, we are not aware at this time of any industry in Wisconsin to which this recommendation now applies.

Recommendation No. 10. This relates to nuclear discharges and thermal pollution. I will defer any comments until we see that report.

Recommendation #11 - Dredging

The dumping of polluted material into any water of the State is prohibited by sections 29.288 of the Wisconsin Statutes. The Corps of Engineers and FWPCA in a joint news release of January 6, 1969, announced that their agencies had work well under way on a cooperative pilot study of dredge spoil disposal methods and had reached an agreement on an interim disposal program. And we have participated with the Corps of Engineers in some of their preliminary meetings with our communities in Wisconsin.

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Recommendation No. 12 covers the alewife project of last summer.

Each of the four States contributed $62,500, which was matched by $250,000 of Federal funds, to cope with the anticipated alewife die-off problem. Skimming operations in Wisconsin were out of Milwaukee and Racine-Kenosha. Two employees of the Department were assigned to observe these operations, make beach checks and supervise the disposal of the alewives. The municipalities involved agreed to provide dock facilities and to transport and dispose of the alewives. Although the alewives didn't cooperate and the die-off did not occur, experience gained should place the participants in a better position to handle the problem should the condition again develop.

Recommendation #13 - Watercraft Pollution

In accordance with proposals agreed upon by representatives of the Conferees, a bill has been prepared for introduction in the current session of the Wisconsin Legislature. This bill will require holding tanks or incineration facilities on all boats equipped with toilets and operating on inland or outlying waters of the State. This covers all waters within the jurisdiction of the State. All residue from onboard facilities is to be disposed of at shore installations. The Statute will apply to all boats, including commercial vessels on interstate waters, until Federal statutes are applied. A copy of the proposed bill that is endorsed by the Department and the Wisconsin Natural Resources Council of State Agencies is Attachment C.

Recommendation #15 - Pesticides

A staff member participated in preparing the "Report on Insecticides in Lake Michigan." This report was submitted to the Conferees on November 18, 1968. In accordance with the committee recommendation a bill has been introduced in the State Legislature under the sponsorship of the Natural Resources Council of State Agencies to more stringently regulate application of pesticides and insecticides. A copy of the bill is Attachment D.

The Department has before it a request for a ruling to ban the use of DDT in the State where

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such use contributes to water pollution and violates State water quality standards. Since this matter is presently in the public hearing stage, we will, of course, have to limit comment on those proceedings.

It should further be noted that two bills have been introduced in the State Legislature at this session to completely ban the use of DDT.

Recommendation No. 16 relates to agricultural pollution. We will pass on that until we hear the report from the USDA.

Recommendation #17 - Water Quality Monitoring

A staff member participated in the development of the report, "Water Quality Monitoring Program for Lake Michigan and Tributary Basin." This report was dated November 15, 1968, and submitted to the Conferees on January 16, 1969. The Department is in substantial agreement with the report that has been received and supports the recommendation therein.

Recommendation #18 - Oil Pollution

In response to Recommendation No. 18, field personnel of the Department inventoried all sites where potential exists for a major spill of oils and other hazardous materials which might affect the water quality of Lake Michigan. The listing, together with suggested corrective measures and maps showing the sites, was sent to the other Conferees on September 18, 1968. Recent events off the California coast would dictate that an intensive oil pollution control and protection program be developed by all governmental agencies concerned.

Recommendation #19 - Water Quality Analyses

It has been recommended that water from the filtration plants at Milwaukee and Green Bay be analyzed for a broad spectrum of water quality parameters including planktonic algae.

The Milwaukee intake at Texas Avenue has been used since 1960 as the sampling point for FWPCA water quality surveillance systems. Samples are analyzed every two weeks for planktonic algae and weekly for chemical parameters. The city of Milwaukee also analyzes daily for bacteriological organisms, turbidity, pH and alkalinity. The intake is located 7600 feet from shore at the south end of the harbor area and takes water from a 40-foot depth.

The city of Green Bay water intakes are located some 20 miles east of Green Bay, near Kewaunee. One intake is located 6000 feet from the shore and takes water from a 50-foot depth. A second intake, built in 1968, is 3000 feet in length and takes water from a 25-foot depth. Water from these intakes is chlorinated at the lift station which is near the shoreline. By the time the water reaches the treatment plant, the water has been effectively disinfected.

Because of the difficulty in obtaining and transporting a representative sample from the Green Bay intake, we believe the city of Two Rivers water intake would be a better location for the water quality analyses recommended by the Conferees. It is located 24 miles south of the Green Bay intakes, and has a length of 6100 feet and takes water from a 31-foot depth. The intake pipe goes directly into the filtration plant so a sample can be obtained more easily and with a lesser time lag. The Two Rivers plant analyzes daily for alkalinity, pH, turbidity, and coliforms.

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While the Two Rivers plant has a certified lab, it does not have the capability to take on extensive analytical work. We believe that to obtain the best information, the station should be included with Milwaukee in the FWPCA surveillance system as part of Federal responsibility in the monitoring of Lake Michigan waters.

Examination of the data taken from the Milwaukee intake sample analyses shows very little change in most of the chemical data from week to week. The plankton data varies considerably, but there is not a large variation in species. Analysis of these samples once monthly should provide satisfactory data. We ask the Conferees to bear in mind that the water utilities are doing daily monitoring for operational purposes and we as Conferees are primarily interested in long term trends.

We are awaiting the report from the U. S. Coast Guard concerning monitoring activities.

Recommendation No. 21, again on oil pollution.

All significant controllable discharges of oil to Wisconsin's lakefront areas have been eliminated. The two manufacturers along the lake who have had oil disposal problems in the past have implemented in-plant control and have instituted awareness programs. One company is currently studying the flotation-incineration equipment previously referred to and the other has submitted preliminary design proposals for further oil loss control facilities.

One small, but particularly vexing, problem has arisen from winterizing practices on vessels that berth in Lake Michigan harbors. In the late fall, these vessels place considerable quantities of grease in plumbing and piping to prevent damage from freezing. In the spring, these lines are flushed out, usually by steam, and the oils and grease are discharged directly to the lake. Although the volumes are small, we believe that isolated instances of oil washing on the shore result from these practices.

We are presently pursuing this matter to obtain better control and explore procedures to minimize the quantities of oils and greases from those sources. Any comments that the FWPCA or other Conferees may have on this special problem would be appreciated.

Recommendation No. 22 covers some of the special research that is being sponsored by the Department. An attachment has been added to this report and I won't discuss it at this time.

Recommendation No. 24 deals with construction grants. We recognize that the statement that follows is perhaps out of the purview and legal responsibility of the Conference, but we would like to at least make a point.

The State Conferees should reiterate the need for full appropriation of grant authorizations in the Federal Water Pollution Control Act and should request a change in distribution formula so that States participating financially in construction projects will not have their control programs adversely affected because fewer projects can be commenced on the 50 percent grant basis than on the 30 percent basis.

In conclusion, the Wisconsin concern for water purity is best illustrated by Governor Knowles' recent proposal for an Outdoor Resources Action Plan - 200. ORAP - 200 if endorsed by the citizens of Wisconsin and enacted by the Legislature would establish a $200 million bonding program--$144 million for construction of sewage treatment facilities and $56 million for outdoor recreational opportunities.

Under Wisconsin law, the bonding program can be enacted by the Legislature without a public referendum. However, the present proposal is to submit an advisory referendum to the electorate in April. If the results are favorable, the next step would be for the Legislature to enact the required legislation. The program would become effective on July 1, 1969, or soon thereafter.

The proposed ten-year program would accelerate the construction of badly needed pollution control facilities by providing a direct, immediate payment of a 25 percent share of State funds, a pre-financing of one-half of the Federal share and application of annual Federal grant funds to insure that local communities would receive at least 55 percent of the cost of eligible construction projects. If Federal grant funds are adequate, additional grants would be awarded to all projects to provide, over a ten-year period, a 75 percent contribution of non-local funds to the projects. Successful implementation of the proposed Wisconsin ORAP-200 program would provide the impetus to achieve the mutual goals and objectives of these proceedings.

That concludes our report.

MR. STEIN: Mr. Frangos, without objection your whole report will be included as if read.

MR. FRANGOS: Yes, please.

(The following are the documents submitted by Mr. Frangos:)

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

SOME HELPFUL INFORMATION SO WE MAY REALIZE THE
INTERRELATION WITH AND THE DEPENDENCE
UPON...
OUR NATURAL RESOURCES

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
Division of Environmental Protection

PROGRESS REPORT

LAKE MICHIGAN ENFORCEMENT CONFERENCE
(Second Session)

February 25, 1969

T. Frangos

The following is a summary report that outlines the response of the Wisconsin Department of Natural Resources to the recommendations of the first session of the Lake Michigan Enforcement Conference and details actions that have been taken in Wisconsin to achieve compliance with the several recommendations. This report is deliberately brief so that the Conference may proceed with the business before the second session. However, we felt that it would be useful to expand on some of the materials previously submitted to the Conference and to summarize the status of the Wisconsin abatement program. Additionally, we have several proposals to make to the Conference in the nature of clarification of the interpretation of several of the recommendations of the first session of the Conference.

The following comments have been itemized to correspond with the recommendation numbers as they appear in the Summary of Conference (first session).

Recommendation #1 - General Waste Treatment Requirements

The interstate water quality standards for Lake Michigan that have been established and approved by the Secretary of Interior provide for secondary treatment for all municipal wastes. Implementation of this requirement will be substantially accomplished by December 1972.

The requirement that "...waste treatment is to be provided by all municipalities to achieve at least 80 percent reduction of total phosphorus..." if literally interpreted and applied is particularly inflexible and has produced administrative problems, especially with our smaller communities. Upon review of the Wisconsin phosphorus contribution from municipal sources, it seems to us that the objectives of this recommendation could better be met by accounting for the total phosphorus load to the drainage basin against which a reduction of 80 percent could be made. An analysis of population distribution of communities within the Wisconsin portion of the Lake Michigan drainage basin shows that 11 out of 177 listed municipal sources account for 83 percent of the population in the basin. A total of 15 communities account for almost 86 percent of the population while 33 communities account for 92 percent of the population. Population distribution is illustrated by the following table:

Size	Cumulative No. of Sources	Percent of Population
20,000	11	83.0
10,000	15	85.8
5,000	33	92.0
2,500	48	94.7
all	177	100.0

In arriving at conclusions as to the application of phosphorus removal requirements, the following items were seriously and extensively reviewed and considered:

1. A review of research activities and information available from other investigations over the past twelve months leads us to conclude that it is very likely that phosphorus removals considerably in excess of 80 percent can be achieved at large, well operated sewage treatment plants. On the other hand, it is unrealistic to expect to obtain this same kind of closely supervised operation that present technology requires for high efficiencies of smaller facilities.

2. Recent surveys of sewage treatment

plant operations throughout the State indicate that, on an average, phosphorus reductions obtained by conventional treatment plants appear to be in the 20-40 percent range.

3. The Wisconsin Department of Natural Resources is presently considering the issuance of a statewide policy to cover phosphate removal at municipal treatment plants. This policy would take into account eutrophication problems on our inland waters. The current proposal would require phosphorus removal at those facilities where the receiving water body has severe problems of overfertilization. It is hoped that the newly proposed algal growth potential test presently being developed by the Joint Industry-Government Task Force will provide all regulatory agencies with a tool that will permit assessment of benefits that can be achieved by reducing phosphorus contributions from point source discharges. As the policy requirements are implemented, it can be expected that a number of smaller communities will need to remove phosphorus.

In view of the population distribution in Wisconsin and in light of the various factors presently at work as described above, it is suggested that the

Conference consider and adopt an approach that considers phosphorus reduction requirements against the total phosphorus load in each State that is tributary to Lake Michigan. This approach would be comparable to that taken in the Lake Erie Enforcement Conference.

If this approach is acceptable to the Conference, the phosphorus reduction requirement will be applied to all Wisconsin municipalities with a population of 5,000 or greater. (See Attachment A.) In consideration of removals achieved at these 33 communities, reductions obtained at conventional treatment plants in smaller communities and the application of a general Statewide policy, it is felt that the Wisconsin phosphorus reduction will substantially meet the objectives of the Enforcement Conference by December 1972.

Recommendation #2, #8 - Industrial Wastes

All industries located within the basin shall meet requirements of the approved Wisconsin interstate water quality standards, as well as the intrastate standards now in effect. Compliance by industries with the established standards will prevent the degradation of water quality in Lake Michigan.

It has been the operating practice of the Department of Natural Resources for many years to encourage industries to discharge wastes that are amenable to treatment to municipal sewer systems when available. This practice is presently being maintained.

Recommendation #3 - Abatement Schedules

In accordance with the recommendations of the Lake Michigan Enforcement Conference, Wisconsin Division of Environmental Protection has prepared and submitted to all Conferees two lists of municipalities and industries discharging wastewater to the Lake Michigan Basin. The first listed the 436 potential waste sources within the basin. The second listed the 111 waste sources within the basin which in our judgment have an effect upon Lake Michigan water quality. The following information was given for each waste source: Location of the facility by river basin and receiving stream, type of waste, flow (MGD), population served, existing treatment, required additional treatment, and the estimated date of completion for additional requirements.

It should be noted that the list does not specifically comment on needs for controlling pollution from combined sources. This is a blanket requirement for all communities where this problem exists in accordance with Recommendation #7. This information can be supplied.

The listing of phosphorus removal requirements was made on the basis of "all" municipalities. The schedule will need to be amended on the basis of acceptance by the Conferees of the proposed approach for reducing phosphorus discharge in the Lake Michigan drainage basin.

Attachment B to this report contains a summary of the status of industrial waste sources in the basin with a brief discussion of progress. It also contains errata that should be incorporated into the history of Wisconsin wastewater sources in Lake Michigan drainage basin affecting Lake Michigan water quality.

Subsequent to receipt of the Summary of Conference, the Wisconsin Department of Natural Resources issued orders and letters to all municipalities citing the need for compliance with State water quality standards and the Enforcement Conference recommendations. Orders were issued in those instances where public hearings had been conducted immediately following the convening of the Lake Michigan Conference. Letters were sent to those dischargers located in sub-basins for which public hearings had not been held. On the basis of drainage basin surveys conducted this past year, public hearings will be conducted in the next few months in much of the area in the Lake Michigan basin. Orders issued subsequent to those hearings will legally reinforce requirements now covered by letter issued by the Department.

Because of the interest previously expressed at the first session over poor water quality conditions of the Fox River between Lake Winnebago and Green Bay, a brief discussion of actions under way is presented at this point. This area was the subject of a public hearing some 11 months ago and orders were issued against all municipalities and industries that are required to meet State water quality standards and the applicability requirements of the Lake Michigan Enforcement Conference. Treatment facilities to meet water quality standards that relate to dissolved oxygen, suspended solids and phosphorus removal are to be

T. Frangos

substantially accomplished by December 1972.

Because of the complex water quality problems in this portion of the Fox River, a number of steps have been taken by municipalities and industries and the Department, all of which are in accord with several of the Lake Michigan Enforcement Conference recommendations.

Four pulp and paper industries and the city of Green Bay have been undertaking a research investigation (partially funded by the Federal Water Pollution Control Administration) to determine the feasibility of joint municipal industrial treatment facilities. Results to date appear promising. A decision by those involved with the research as to whether to proceed to a joint treatment facility is expected by January 1970.

Some 15 industries and several municipalities at the southern end of the Fox River are cooperating in a joint study undertaken by the Fox Valley Council of Governments to determine the feasibility of a joint sewage system at that area of the river. This study is sponsored, in part, by the Department of Housing and Urban Development. A decision on whether to proceed on this proposal is expected by January 1970.

Because of the intensive use of the Fox River, the water quality conditions are complex. In order to more accurately predict river response to anticipated reductions in waste loadings and to assist the Department in administering its water pollution control program, the Department has contracted with a consultant engineering firm to develop a mathematical water quality model of the Fox River. It is expected that the availability of a predictive tool will enable the Department to more precisely assess water quality conditions and to more firmly establish treatment requirements. It should be noted that much of the basic data that is required to develop a mathematical model was provided by the Federal Water Pollution Control Administration as a result of field surveys it had conducted several years ago. The model will be available to the Department by July 1, 1969.

Although timing of the several activities now under way is critical, it is still anticipated that required facilities will be constructed and operating by December 1972. In the meantime, the orders issued by the Department require that industries and municipalities proceed immediately with whatever work can be accomplished without prejudice, pending decisions on the studies described above.

Recommendation #4 - Municipal Waste Disinfection

Wisconsin has accepted the Lake Michigan Enforcement Conference recommendation concerning continuous disinfection for all municipal treatment plant effluents. It is Statewide policy that throughout the year all municipal treatment plants must provide continuous disinfection. All municipal sources within the Lake Michigan Basin which do not provide continuous disinfection have received either orders or letters requiring preliminary reports and time schedules for the installation or operation of facilities by May 1969.

Recommendations #5 and #15 - Areawide Sewerage Systems

For many years the State of Wisconsin has promoted the installation of unified collection systems and areawide sewage facilities. We have continued this practice in agreement with recommendations #5 and #14 of the Lake Michigan Enforcement Conference.

It is also appropriate to comment on two activities now under way in the Milwaukee metropolitan area. The Southeastern Wisconsin Regional Planning Commission (SEWRPC) has received a grant from the Federal Water Pollution Control Administration to develop a detailed water quality management program for the Milwaukee River watershed. An important element of this study will be the development of alternative institution arrangements for water quality management.

Concurrently, SEWRPC has also initiated a study to determine the feasibility of developing an areawide sewerage system for the highly urbanized seven-county area in the southeast part of the State.

Recommendation #6 - Bypassing

The major combined sewerage systems in Wisconsin have been designed and built with suitable overflow structures which insure the full utilization of the capacity of the intercepting sewers. Action is being taken to minimize bypassing whenever possible. All orders issued by the Department contain requirements for reducing bypassing from combined sewers or where "clear water" problems exist. Flow regulating devices may be effective in an overall program of reducing pollution from combined wastes.

Recommendation #7 - Combined Sewers

Combined sewered areas are being separated in relation to urban renewal projects and whenever reconstruction projects permit such separation. No new combined sewers are being installed; however, structurally unsound existing combined sewers are being replaced in limited instances when it is not possible to separate the tributary sewers.

Techniques for handling combined sewage other than separation are being investigated. Federal demonstration grants have been obtained by the cities of Chippewa Falls and Milwaukee to investigate such techniques. Chippewa Falls is discharging high stormwater flow to a holding pond where the sewage will be stored until the flow subsides sufficiently to allow the pond contents to be directed to the treatment facility. The city of Milwaukee is installing a tank which will also store combined sewage for pumping to the interceptor sewers when the high flow subsides. This facility will be provided with chlorination equipment to allow primary sedimentation and disinfection of the combined sewage flow prior to discharge to the river when the flow exceeds the capacity of the tank. Provisions are made in both demonstration projects to provide records of flow volumes and treatment provided.

Recommendation #9 - Disinfection - Industrial Wastes

We are in agreement with the recommendation that continuous disinfection be provided for industrial effluents containing pathogens which may have a deleterious effect on persons coming into contact with Lake Michigan waters. However, we are not aware at this time of any industry in Wisconsin to which this recommendation now applies.

Recommendation #10 - Nuclear Discharges and Thermal Pollution

A staff member participated in the development of "Report of the Committee on Nuclear

Power Plant Waste Disposal to the Conferees of the Lake Michigan Enforcement Conference." This report was submitted to the Conferees on November 27, 1968. Wisconsin is in substantial agreement with the recommendations contained in that report.

Recommendation #11 - Dredging

The dumping of polluted material into any waters of the State is prohibited by ss. 29.288 of the Wisconsin Statutes. The Corps of Engineers and FWPCA in a joint news release of January 6, 1969, announced that their agencies had work well underway on a cooperative pilot study of dredge spoil disposal methods and had reached an agreement on an interim disposal program. In January, the Department participated in meetings with the Corps of Engineers and local officials at six of Wisconsin's Lake Michigan port cities. The discussions involved dredging operations and disposal areas.

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Recommendation #12 - Alewives

Last summer, each of the four States contributed $62,500 which was matched by $250,000 of Federal funds to cope with the anticipated alewife die-off problem. Skimming operations in Wisconsin were out of Milwaukee and Racine-Kenosha. Two employees of the Department were assigned to observe these operations, make beach checks and supervise the disposal of the alewives. The municipalities involved agreed to provide dock facilities and to transport and dispose of the alewives. Although the die-off did not occur, experience gained should place the participants in a better position to handle the problem should the condition again develop.

Recommendation #13 - Watercraft Pollution

In accordance with proposals agreed upon by representatives of the Conferees, a bill has been prepared for introduction in the current session of the Wisconsin Legislature. This bill will require holding tanks or incineration facilities on all boats equipped with toilets and operating on inland or outlying waters of the State. This covers all waters within the jurisdiction of the State. All residue from onboard facilities is to be disposed of at shore installations. The Statute will apply to all boats, including commercial vessels on interstate waters until Federal statutes are applied. A copy of the proposed bill that is endorsed by the Department and the Wisconsin Natural Resources Council of State Agencies is Attachment C.

Recommendation #15 - Pesticides

A staff member participated in "Report on Insecticides in Lake Michigan." This report was submitted to the Conferees on November 18, 1968. In accordance with the committee recommendation a bill has been introduced in the State Legislature under the sponsorship of the Natural Resources Council of State Agencies to more stringently regulate application of pesticides and insecticides. A copy of the bill is Attachment D.

The Department has before it a request for a ruling to ban the use of DDT in the State where such use contributes to water pollution and violates

State water quality standards. Since this matter is presently in the public hearing stage, we will, of course, have to limit comment on those proceedings.

It should further be noted that two bills have been introduced in the State Legislature at this session to completely ban the use of DDT.

Recommendation #16 - Agricultural Pollution

Since most of the pollution and siltation problems arising from agricultural practices are non-point sources, and therefore more difficult to control, it appears that a broad, multifaceted program is required. Education will be an important factor. We look forward to receiving the comments of the U. S. Department of Agriculture.

Recommendation #17 - Water Quality Monitoring

A staff member participated in the development of the report, "Water Quality Monitoring Program for Lake Michigan and Tributary Basin." This report was dated November 15, 1968, and submitted to the Conferees on January 16, 1969. The Department is in substantial agreement with the report that has been received and supports the recommendation therein.

Recommendation #18 - Oil Pollution

In response to recommendation #18, field personnel of the Department inventoried all sites where potential exists for a major spill of oils and other hazardous materials which might affect the water quality of Lake Michigan. The listing, together with suggested corrective measures and maps showing the sites, was sent to the other Conferees on September 18, 1968. Recent events off the California coast would dictate that an intensive oil pollution control and protection program be developed by all governmental agencies concerned.

Recommendation #19 - Water Quality Analyses

It has been recommended that water from the filtration plants at Milwaukee and Green Bay be analyzed for a broad spectrum of water quality parameters including planktonic algae.

The Milwaukee intake at Texas Avenue has been used since 1960 as the sampling point for FWPCA water quality surveillance systems. Samples are analyzed every two weeks for planktonic algae and weekly for chemical parameters. The city of Milwaukee also analyzes daily for bacteriological organisms, turbidity, pH, and alkalinity. The intake is located 7600 feet from shore at the south end of the harbor area and takes water from a 40-foot depth.

The city of Green Bay water intakes are located some 20 miles east of Green Bay, near Kewaunee. One intake is located 6000 feet from the shore and takes water from a 50-foot depth. A second intake, built in 1968, is 3000 feet in length and takes water from a 25-foot depth. Water from these intakes is chlorinated at the lift station which is near the shoreline. By the time the water reaches the treatment plant, the water has been effectively disinfected.

Because of the difficulty in obtaining and tramsporting a representative sample from the Green Bay intake, we believe the city of Two Rivers water intake would be a better location for the water quality analyses recommended by the Conferees. It is located 24 miles south of the Green Bay intakes, and has a length of 6100 feet and takes water from a 31-foot depth. The intake pipe goes directly into the filtration plant so a sample can be obtained more easily and with a lesser time lag. The Two Rivers plant analyzes daily for alkalinity, pH, turbidity, and coliforms.

While the Two Rivers plant has a certified lab, it does not have the capability to take on extensive analytical work. We believe that to obtain the best information, the station should be included with Milwaukee in the FWPCA surveillance system as part of Federal responsibility in the monitoring of Lake Michigan waters.

Examination of the data taken from the Milwaukee intake sample analyses shows very little change in most of the chemical data from week to week. The plankton data varies considerably, but there is not a large variation in species. Analysis of these samples once monthly should provide satisfactory data. Bear in mind that the water utilities are doing daily monitoring for operational purposes and we as Conferees are primarily interested in long term trends.

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Recommendation #20 - U. S. Coast Guard Monitoring Activities

Report to be received.

Recommendation #21 - Oil Pollution

All significant controllable discharges of oil to Wisconsin lakefront areas have been eliminated. The two manufacturers along the lake who have had oil disposal problems in the past have implemented in-plant control and have instituted awareness programs. One company is currently studying the flotation-incineration equipment previously referred to and the other has submitted preliminary design proposals for further oil loss control facilities.

One small, but particularly vexing, problem has arisen from winterizing practices on vessels that berth in Lake Michigan harbors. In the late fall, these vessels place considerable quantities of grease in plumbing and piping to prevent damage from freezing. In the spring, these lines are flushed out, usually by steam, and the oils and grease are discharged directly to the lake. Although the volumes are small, we believe that isolated instances of oil washing on the shore result from these practices.

We are presently pursuing this matter to obtain better control and explore procedures to minimize the quantities of oils and greases from those sources. Any comments that the FWPCA or other Conferees may have on this special problem would be appreciated.

Recommendation #22 - Research

We agree that there is a great need for aggressive water pollution research and that we cannot wait until all the answers are "in" before taking action. We must, however, avoid the pitfall of predicting or suggesting program results in those areas where we have so little knowledge of "cause" and "effect" relationships.

The Wisconsin Legislature has provided funds specifically for water resources research. During the past two years some $500,000 has been available to the Department to conduct a broad water research program. The investigations sponsored or undertaken by the Division of Environmental Protection span a wide range of water supply and water pollution control problems. A summary of projects undertaken by the Division appears in Attachment E.

Recommendation #24 - Construction Grants

The State Conferees should reiterate the need for full appropriation of grant authorizations in the Federal Water Pollution Control Act and should request a change in distribution formula so that States participating financially in construction projects will not have their control programs adversely affected because fewer projects can be commenced on the 50 percent grant basis than on the 30 percent basis.

* * *

The Wisconsin concern for water purity is best illustrated by Governor Knowles' recent proposal for an Outdoor Resources Action Plan - 200. ORAP - 200 if endorsed by the citizens of Wisconsin and enacted by the Legislature would establish a $200 million bonding program--$144 million for construction of sewage treatment facilities and $56 million for outdoor recreational opportunities.

Under Wisconsin law, the bonding program can be enacted by the Legislature without a public referendum. However, the present proposal is to submit an advisory referendum to the electorate in April. If the results are favorable, the next step would be for the Legislature to enact the required legislation. The program would become effective on July 1, 1969, or soon thereafter.

The proposed ten-year program would accelerate the construction of badly needed pollution control facilities by providing a direct, immediate payment of a 25 percent share of State funds, a pre-financing of one-half of the Federal share and application of annual Federal grant funds to insure that local communities would receive at least 55 percent of the cost of eligible construction projects. If Federal grant funds are adequate, additional grants would be awarded to all projects to provide, over a ten-year period, a 75 percent contribution of non-local funds to the projects. Successful implementation of the proposed Wisconsin ORAP-200 program would provide the impetus to achieve the mutual goals and objectives of these proceedings.

Attachment A.

LISTING OF MAJOR WISCONSIN MUNICIPALITIES IN THE LAKE MICHIGAN BASIN

Population Between 5,000 and 10,000

- Cedarburg, City
- Franklin San. Dist. #1
- Germantown, Vil.
- Greendale, Vil.
- Hales Corners, Vil
- Kimberly, Vil.
- Little Chute, Vil.
- Menasha, Tn. San. Dist #4
- Mequon, City
- New London, City
- Oak Creek, City
- Plymouth, City
- Portage, City
- Port Washington, City
- Ripon, City
- Shawano, City

Population over 10,000

- Appleton, City
- De Pere, City
- Green Bay Met. Sewer Dist.
- Kaukauna, City
- Kenosha, City
- Manitowoc, City
- Menominee Falls, Vil.
- Milw, Met. Sew. Comm. (2 plants)
- Neenah-Menasha, Cities
- Oshkosh, City
- Racine, City
- Sheboygan, City
- South Milwaukee, City
- Two Rivers, City
- West Bend, City

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Population Between
5,000 and 10,000 (Cont'd.)

Shawano Lake San. Dist.

Sturgeon Bay, City

Attachment B

Status

Industrial Waste Sources

Lake Michigan Enforcement Conference

February 25, 1969

The list titled "Wisconsin Waste Water Sources in the Lake Michigan Drainage Basin Affecting Lake Michigan Water Quality" which was submitted in November 1968 names 40 industry-owned outfalls as potential sources of pollution affecting Lake Michigan. Of those named, 1[illegible] are indicated as not affecting the lake quality and as not requiring additional treatment. One additional industry, the Kimberly-Clark Corporation Lakeview Mill at Neenah, has recently placed in operation an industrial waste unit which may achieve an acceptable level of treatment.

There was one omission from this listing.

T. Frangos

The name of the U. S. Glue Division, Peter Cooper Corporation, located at Oak Creek, should be added. Negotiations between this company and the city of Milwaukee Metropolitan Sewerage District are in progress for connection to the metropolitan sewage collection system.

There were four erroneous inclusions:

1. Oak Creek Power Plant (Wisconsin Electric Power Company) which has a seepage lagoon in addition to a secondary plant for its sewage treatment and therefore there is no requirement for effluent disinfection by May of 1969.

2. Falls Paper and Power Company which is now the Scott Paper Company, Oconto Falls, has existing treatment consisting of primary clarification, sludge centrifugation, evaporation and roadbinder hauling in addition to the lagooning and saveall s indicated.

3. Kimberly-Clark Corporation's mill at Niagara on the Menominee River has discontinued all chemical pulping and therefore does not create adverse conditions in Lake Michigan. This mill has in progress certain improvements which, when completed, are expected

to result in a significant reduction in suspended solids discharged to the Menominee River.

4. Scott Paper Company at Marinette on the Menominee River was incorrectly credited with primary clarification, sludge centrifugation, evaporation and ponding. Their existing treatment should be changed to savealls,screens and roadbinder hauling.

Three of the forty listed industrial sources convey inadequately treated sanitary sewage. In two of these instances we have received responses from the industries confirming their intent to connect to municipal sewers.

Of the 21 industrial process waste pollution sources not yet mentioned, 17 are on the Fox River. All acknowledged orders or letters received from this Department and have given their assurances that they will meet the requirements of our existing State water quality standards and the requirements of the Lake Michigan Enforcement Conference. Those with the less complex problems will probably accomplish this in advance of December 1972.

Fifteen of the Fox River mills are

actively exploring connection of all or part of their wastes to municipal sewer systems. Four of these are already partially connected to city sanitary sewers. All but those four are simultaneously considering methods of separate treatment which can be employed if the municipal sewer connections are ruled out.

Of the remaining four industries, three have discharges presently going to Lake Michigan and one is to the Pike River.

Preliminary engineering proposals have been submitted for Departmental review by two of these firms, and one of those proposals has already been approved. A third company with a waste containing ions potentially detrimental to aquatic life has submitted results of bioassays of treated effluent similar to that which they would release from proposed treatment units. Once this Department determines the concentration limits for those ions the company plans to proceed with preparation of construction drawings.

The remaining corporation has in-plant oil interception and reclamation equipment. It is also studying flotation and incineration to improve control techniques.

T. Frangos

Attachment C

AN ACT*

To repeal and recreate 30.71 (2) of the statutes relating to boat toilet regulations.

The people of the State of Wisconsin, represented in senate and assembly do enact as follows:

30.71 (2) of the statutes is repealed and recreated to read:

30.71 (2) No person shall operate any boat equipped with toilets on any outlying waters of this State, as defined in Sec. 29.01 (4), unless the toilet wastes are retained for shore disposal by means of facilities constructed and operated in accordance with rules adopted by the department of health and social services. This subsection shall not apply to boats engaged in international or interstate commerce.

This act shall take effect on January 1, 1970.

12/16/68 js

* Proposed bill, has not as yet been introduced in the Legislature.

Attachment C-1

STATE OF WISCONSIN / DEPARTMENT OF NATURAL RESOURCES

L. P. Voigt
Secretary

Box 450
Madison, Wisconsin 53701

30.71 WISCONSIN STATUTES

30.71 Boats equipped with toilets

(1) No person shall operate any boat equipped with toilets on inland waters of this State, except the Mississippi River, unless the toilet wastes are retained for shore disposal by means of facilities constructed and operated in accordance with the rules adopted by the state board of health. "Inland waters" means the waters defined as inland waters by s 29.01 (4).

(2) Until October 31, 1967, sub. (1) shall not apply to the St. Croix River below Houlton-Stillwater.

Attachment D

1969

STATE OF WISCONSIN

1969 SENATE BILL 124

LRB-980
MRT:mjg:1
BC: :2

February 6, 1969 - Introduced by COMMITTEE ON CONSERVATION, by request of Natural Resources Council of State Agencies. Referred to Committee on Conservation.

AN ACT to amend 29.60 (5) (c); to repeal and recreate 29.29 (4); and to create 15.191 (2), 15.195, 94.69 (8), (9) and (10), 140.05 (15) and 140.77 of the statutes, relating to the use of pesticides, creating a pesticide review board, and granting rule-making power.

Analysis by the Legislative Reference Bureau

This proposal creates, in the department of health and social services, a pesticide review board to coordinate the pesticide control responsibilities of all State agencies. The council consists of three members: the secretaries of natural resources, of agriculture, and of health and social services; each secretary may, however, designate somebody else to serve in his stead.

No rule regulating the use of pesticides can enter into effect without the approval of the pesticide review board.

The review board will be assisted in obtaining scientific data, and in coordinating the pesticide regulatory,enforcement, research and educational functions of the State, by a nine-member council on which, in addition to representatives of other governmental agencies or the general public, the departments of agriculture, of health and social services, and of natural resources, and the university of Wisconsin, will be represented.

For further information, see the fiscal note appended to this bill.

The people of the State of Wisconsin, represented in senate and assembly, do enact as follows:

SECTION 1. 15.191 (2) of the statutes is created to read:

15.191 (2) PESTICIDE REVIEW BOARD. The pesticide review board shall have the program responsibilities specified under ss. 29.29 (4), 94.69 (9) and 140.77.

SECTION 2. 15.195 of the statutes is created to read:

15.195 SAME; ATTACHED BOARDS AND COMMISSIONS. (1) PESTICIDE REVIEW BOARD. There is created in the department of health and social services a pesticide review board. The review board shall consist of the secretary of agriculture, the secretary of health and social services and the secretary of natural resources or their designated representatives.

SECTION 3. 29.29 (4) of the statutes is repealed and recreated to read:

29.29 (4) USE OF PESTICIDES. The department of natural resources, after public hearing, may adopt rules governing the use of any pesticide which it finds is a serious hazard to wild animals, and the making of reports thereon. In making such determinations, the department to the extent relevant shall consider the need for pesticides to protect the well-being of the general public. It shall obtain the recommendation of the pesticide review board and such rules are not effective until approved by the pesticide review board. "Pesticide" has the meaning designated in s. 94.67 (1).

SECTION 4. 29.60 (5) (c) of the statutes is amended to read:

29.60 (5) (c) Nothing in this chapter shall prevent the department or its wardens from using dynamite or having dynamite in possession near beaver houses or dams for the purpose of removing beaver dams when the beavers are causing damage to property owners.

SECTION 5. 94.69 (8), (9) and (10) of the statutes are created to read:

94.69 (8) To govern the conditions under which containers of pesticides may be transported, stored or disposed of.

(9) To govern the use of pesticides, including their formulations, and times and methods of application and other conditions of use.

(10) No rule hereunder shall be adopted unless the department determines that it is necessary for the protection of persons or property from serious pesticide hazards and that its enforcement is feasible and will substantially eliminate or reduce such hazards.

In making such determination the department, to the extent relevant, shall consider the toxicity, hazard, effectiveness and public need for the pesticides, and the availability of less toxic or less hazardous pesticides or other means of pest control. It shall obtain the recommendations of the pesticide review board and such rules are not effective until approved by the pesticide review board. Such rules shall not affect the application of any other statute or rule adopted thereunder.

SECTION 6. 140.05 (15) of the statutes is created to read:

140.05 (15) Where the use of any pesticide results in a threat to the public health, the department of health and social services may take all measures necessary to prevent morbidity or mortality.

SECTION 7. 140.77 of the statutes is created to read:

140.77 PESTICIDE REVIEW BOARD. (1) The pesticide review board created by s. 15.195 shall collect, analyze and interpret information, and make recommendations to and coordinate the regulatory and informational responsibilities of the State agencies, on matters relating to the use of pesticides, particularly recommendations for limiting pesticide use to those materials and amounts thereof found necessary and effective in the control of pests and which provide the least potential hazard to man, animals or plants. Pesticide rules authorized by ss. 29.29 (4) and 94.69 are not effective until approved by the review board.

(2) The pesticide review board shall appoint a council not to exceed nine members of technical or professional experts composed of one representative each from the department of agriculture, department of health and social services, department of natural resources, university of Wisconsin and such other representatiges of other governmental agencies or the general public as the board designates. The council shall generally assist the review board and shall assist particularly in obtaining scientific data and coordinating pesticide regulatory, enforcement, research and educational functions of the State.

(3) The pesticide review board shall report to the governor and the legislature any pesticide

matters it finds are of vital concern for the protection of the health and well-being of people or for the protection of fish, wildlife, plants, soil, air and water from pesticide pollution. Such report may include its recommendations for legislative or other governmental action.

(End)

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
RESEARCH PROJECT REVIEW
(FEBRUARY 14, 1969)

1968-69
Biennium

PROJECT NUMBER, TITLE, and PRINCIPAL INVESTIGATOR	PROJECT STATUS	BUDGET		STARTING DATE	ENDING DATE	COOPERATING AGENCIES
		ESTIMATED PRIOR COSTS	1968-69 PROPOSED			
WSA - [illegible] - 1. The collection of data in reference to public water supplies and the planning of future requirements in this area. Mr. [illegible] Stravinski	Completed: - Final report in preparation for publication.	$14,000.00	$6,000.00	June, 1965	March 1969	None
WSA - [illegible] - 2. The study of removal of nutrients, etc., in sewage by sub-surface soil percolation method of sewage disposal. Prof. L. B. Polkowski	Completed: - Part of work covered by M. Sc. Thesis final report in preparation for publication.	$19,042.00	$3,577.00	Sept. 1966	Feb. 1969	College of Engineering University of Wisconsin
WSA - [illegible] - 3. Research in reference to sewage effluent ponds. Prof. W. Boyle	Continuing: - Two un - successful field trials have been conducted to date. A third field trial is in progress.	$28,176.00	$12,431.00	Sept. 1966	June, 1969	College of Engineering University of Wisconsin
WSA - WP - 1. An economic evaluation of pollution abatement costs in Wisconsin. Mrs. K. Micke	Completed: - (For Pulp & Paper Ind.) Data on hand. Final report in preparation.	$18,000.00	$6,000.00	Jan. 1967	April, 1969	None
WSA - WP - 2. Automatic water quality monitoring - movable Mr. F. H. Schraufnagel	Continuing. - Equipment in field use for some seven months in 1968 at various points in Wisconsin. Data being analyzed for report.	$30,000.00	--	Oct. 1966	April, 1969	None

1968 - 69
Biennium

PROJECT NUMBER, TITLE, AND PRINCIPLE INVESTIGATOR	PROJECT STATUS	BUDGET ESTIMATED PRIOR COSTS	1968-69 PROPOSED	STARTING DATE	ENDING DATE	COOPERATIVE AGENCIES
WSA - RP - 1. State Water resources plan project. Mr. A. R. Striegl	Completed: - Final report on file.	$10,000.00	--	Oct. 1967	March, 196	(Mr. A. R. Striegl)
WSA - [illegible] - 2. Development of a simulation model for the study of the hydrology of the Wisconsin River Basin Prof. I. Fox	Completed: - Final report completed and circulated.	$25,515.00	--	June 1967	Oct. 1968	Water Re - sources cente University of Wisconsin
WSA - [illegible] - 3. D.E.P. - U. S. G. S. coop. floodplain delineation. Mr. [illegible] Lee	Continuing: - Work completed on the Upper Rock River and work in progress in Jefferson county.	$25,000.00	$40,000.00	Oct. 1967	June, 1969	U. S. Geological surveys.
WSA - [illegible] - 4. Fecal coliform dieoff in sewage treatment lagoons Prof. K. Crabtree	Continuing: - Preliminary field and laboratory trials in progress.	--	$16,537.00	Aug. 1968	June 1970	Wausau University center & University of Wisconsin
WSA - [illegible] - 5. A taxonomic survey of Wisconsin families, genera & species of plecoptera, ephemeroptera, and trichopterans. Prof. [illegible] Hilsenhoff	Continuing: - Large number of field specimen collected for identification and laboratory studies. Two progress reports issued	--	$22,300.00	June 1968	Oct. 1970	University of Wisconsin
WSA - [illegible] - 6. A study of the movement of waste sulfite liquors from the disposal sites at the Badger Paper Mills Peshtigo, Wisconsin Mr. [illegible] A. Calabrese	Continuing: - Extensive field trials are in progress	--	$38,000.00	June 1968	Jan. 1970	University of Wisconsin & Badger Paper Mills.

1968-69
Biennium

[illegible] TITLE, AND [illegible] INVESTIGATOR	PROJECT STATUS	BUDGET		STARTING DATE	ENDING DATE	COOPERATIVE AGENCIES
		ESTIMATED PRIOR COSTS	1968-69 PROPOSED			
[illegible] - [illegible] - 1. Survey of Pesticide Residues in Macro invertebrate benthos organisms. [illegible]	Continuing: - Equipment and personnel acquired. Samples taken in Lake Michigan Basin are being analyzed.	--	$43,630.00	March 1968	June 1969	None
[illegible] - [illegible] - [illegible]. Aerial Photo-gr[illegible] Lakes. [illegible]	Completed: Aerial photo-graphs taken by using different films and filters. Report in preparation.	--	$7500.00	July, 1968	Feb. 1969	University of Wisconsin & Department of Transportation.
[illegible] - [illegible] - 2. Definition of the mixing zone for waste effluent discharged to surface waters. Prof. [illegible]	Continuing: - Literature review completed. Preliminary report submitted.	--	$12,860.00	Sept. 1968	June 1969	College of Engineering University of Wisconsin
[illegible] - [illegible] - 3. Nitrates in Drinking water supplies Prof. [illegible]	Continuing: - Several wells being tested at regular intervals, analyses and other data are being studied.	--	$5954.00	June 1968	June 1969	Wausau University Center.
[illegible] - [illegible]. [illegible]nting low [illegible] streams with ground water.	Continuing: - Field work being carried out under the direction of the Division of Conservation.	--	$7500.00 (by the Div. of Envir. Protection)	June 1968	Nov. 1970	U.S.G.S. and Bureau of Fish Management
[illegible] - [illegible]. Phosphorus removal [illegible] the trickling filter system. [illegible]	Continuing: - Sampling equipment being installed at selected trickling filter systems throughout the state.	--	$7000.00	Oct. 1968	June 1970	College of Engineering University of Wisconsin

PROJECT NUMBER, TITLE, AND PRINCIPAL INVESTIGATOR	PROJECT STATUS	BUDGET		STARTING DATE	ENDING DATE	COOPERATIVE AGENCIES
		ESTIMATED PRIOR COSTS	1968-69 PROPOSED			
No. 1. State of the Art Study of thermal pollution and its control Dr. [illegible]	Completed: Preliminary report drafted. Final report in preparation	--	$5800.00	Oct. 1967	Feb. 1969	None
No. 2. Comparison of membrane filter [illegible] vs. total coliform in evaluation of water quality. Dr. E. R. [illegible]	Continuing: From a literature review and the analyses of various water samples, a preliminary report has been prepared	--	$5000.00	Feb. 1968	Feb. 1969	None
No. 3. Study on the applicability of effluent charges to water quality management in the state of Wisconsin. Prof. I. Fox	Continuing: Preliminary report is on hand	--	$23,940.00	July 1968	Sept. 1969	Water Resource Center, University of Wisconsin

T. Frangos

ORAP 200

The people of Wisconsin have something to say about the kind of outdoors they want. They can make a commitment now that will help over the next dozen years to: (1) fight pollution of the State's waters, and (2) further expand recreational opportunities, making more available to more people.

AN EARLY BOOST

In 1961, the legislature boosted outdoor recreation when it passed ORAP--the Outdoor Recreation Act Program. This act placed a 1¢ tax on a pack of cigarettes, which was used to speed up acquisition and development of lands.

There has been good progress--more chances have been created for fishing, camping, hiking, bird watching, hunting, boating, picnicking, swimming, and for just enjoying the peace of quiet places.

But the job can never get done this way--not at the rate we are growing! Another million people by 1980, or about 250 more every day! The demand is already greater than the supply, and steadily becoming greater. Overcrowding, overuse and misuse even now are threatening the very values we need and want from the outdoors. Furthermore, this growing population is producing more and more wastes--domestic and industrial--which are fouling the lifeblood of the land.

THE NEXT STEP

And so in 1969 there is a new ORAP and a new challenge. ORAP 200 is an Outdoor Resources Action Plan that will probably be presented to the voters of Wisconsin in April asking for a bond issue of $200 million to accelerate water pollution control and outdoor recreation programs.

ORAP 200 is a vital package. It deals with clean water, scenery, wildlife habitat, wilderness, places to recreate and to be recreated--in short, it involves the livability of the environment, as well as the quality of our own living.

It deals with things that matter to all people--businessmen and housewives, young people and the old folks, nature lovers and sports enthusiasts, residents and visitors.

T. Frangos

THE ORAP DOLLAR...$.72 for pollution control

Wisconsin residents use nearly half a billion gallons of water each day for drinking, cooking, bathing, laundry and dishwashing, and flushing away of wastes. These waste-bearing waters are directed to sewers and treatment plants, and ultimately back to our lakes and streams. Most of our sewage plants today can't cope with this burden.

Most communities have recognized their responsibility. They want to do the job, but they are counting on promised Federal funds to help modernize their treatment systems, and these dollars are in short supply.

ORAP 200 can fill this gap and get work rolling by:

DIRECT STATE AID

Wisconsin law permits payment by the State of 25 percent of the cost of approved sewage treatment plants. These payments must, however, be in equal annual installments over a 5- to 30-year period. Funds available through bonding would enable the State to make direct, lump-sum payments instead, easing the financial burden on the municipality.

ADVANCE OF FEDERAL AID

Because of limited funds and prior commitments to certified projects, only 12 top priority pollution abatement projects could be given Federal assistance in Wisconsin this fiscal year. Meanwhile a backlog of some 90 applications for Federal aid has developed, and indications are that we will need nearly 500 project starts in the next 6 years.

Bonding under ORAP 200 would provide funds to advance at least 25 percent of the cost of eligible projects in anticipation of Federal reimbursement. At least $50 million in new project starts could be generated each year until the backlog is eliminated, and continuous upgrading of facilities at a rate of $20 million per year could be assured.

ELIMINATING DELAYS

Funds from these two sources, together with Federal aids available annually, would assure municipalities of at least 55 percent financial assistance. This will:

1. Simplify financing and reduce

interest costs for municipalities.

2. Ease the property tax burden.

3. Assure all communities of equitable treatment.

4. Overcome the tendency to delay making local commitments until matching funds are available.

5. Shift emphasis from just coping with pollution to a positive program of protection of public health, cleaner streams, greater recreational potential.

THE ORAP DOLLAR...$.28 for outdoor recreation

Money spent accelerating and improving the outdoor recreation program will be directed into three main efforts:

MORE RECREATIONAL SPACE

Highest priority in the recreational picture is "a place to go." ORAP money will go toward securing land, developing recreational resources, and operating and maintaining developed areas. Additional recreational space will include city, county and State parks, recrational areas in county forests, and historic sites. In addition, ORAP will provide tax assistance to local governments and technical help for recreation and natural resource planning.

A BETTER RECREATIONAL ENVIRONMENT

Some proposed ORAP programs are aimed at producing a quality environment for fish, wildlife and people--for example, improvement of county forest wildlife habitat, production of coho salmon, creation of new lakes and additional access, planting of shade trees, preservation of already designated wild rivers, and acquiring of scenic easements.

EXPANDED JOB OPPORTUNITIES

Other ORAP programs are designed both to help get development and management work done in the field and,at the same time, provide employment and outdoor experiences--for example, conservation work programs for Milwaukee area residents, and additional conservation youth camps.

ACT NOW!

To meet tomorrow's pressures, today's money source must be changed so that it can grow. The means of financing ORAP 200 recommended by the Governor's

ORAP Task Force is bonding.

Bonding is a well-established practice, and one that can speed up water pollution control and create additional opportunities for outdoor recreation. The dollar will do more work at this time than it will in the inflationary future. Also, the people who will be crowding into the years ahead will be paying their fair share towards maintaining the quality of their environment, and at today's prices.

It is not a crash program. The legislature will be asked each session to approve projects and will issue enough bonds to cover them.

But there is a real sense of urgency now: It is necessary to intensify measures to clean up waters used in waste disposal so that lakes and streams do not become cesspools and sewers. And it is necessary to preserve open space and recreational areas while they are still available--and before spiralling costs place them out of public reach.

About half the States in the country have financed outdoor recreational programs through bonding, and several have underwritten accelerated water pollution control through the same device. The Michigan legislature and people in referendum have just approved a $435 million bond issue--$100 million for recreation and $335 million for pollution control.

Without ORAP there will still be lakes and streams...but will the water be clean enough to drink or to catch fish or swim in?

Without ORAP, there will still be hunting and boating and camping...but will there be space for you?

Without ORAP, there will still be rivers... but will any remain wild and unspoiled for your children?

Without ORAP, there will still be a Wisconsin...but will it be a land in which we can live creatively?

THE WISCONSIN DEPARTMENT
OF NATURAL RESOURCES
BOX 450
MADISON, WISCONSIN 53701
ORAP 200
For Clean Water & A Finer Outdoors

T. Frangos

Let us proclaim a creed to preserve our natural heritage with rights and the duties to respect those right:

The right to clean water--and the duty not to pollute it.

The right to clean air--and the duty not to befoul it.

The right to surroundings reasonably free from man-made ugliness--and the duty not to blight.

The right to easy access of places of beauty and tranquility where every family can find recreation and refreshment--and the duty to preserve such places clean and unspoiled.

The right to enjoy plants and animals in their natural habitats--and the duty not to eliminate them from the face of this earth.

THE PRESIDENT'S MESSAGE TO
THE 89th CONGRESS

- - -

MR. STEIN: Are there any comments or questions?

MR. POSTON: I have.

MR. STEIN: Mr. Poston.

MR. POSTON: For clarification, Mr. Frangos, I note some of the dates which you have set in your schedules for pollution abatement measures, that these are extended beyond what you had originally set under your water quality standards implementation plan. Could you enlighten us on this, what this means?

MR. FRANGOS: The December 1972 date is an outside date that we indicated for purposes of this Conference. In some instances we will get compliance ahead of that date.

With respect specifically to the implementation program, some of those are falling behind. Others that we can meet we are going to continue and press for those deadlines, but we have not used the December 1972 date to extend the time granted to any of our communities. Any time extensions that we will need are based on other factors.

MR. POSTON: In other words, you do not

intend to have any extension of time beyond what was set for the implementation plan and the standards set up--

MR. FRANGOS: That is right, that December 1972 date does not automatically carry anybody beyond what we think is reasonable and upon which we made recommendations and issued legal orders.

MR. POSTON: I wanted to be clear that this Conference was not in any way going to extend any dates for abatement of pollution.

MR. FRANGOS: No, we don't look at this Conference as an excuse for stretching any of this out.

MR. POSTON: The second item that I wanted to comment on was the removal of phosphates from industrial wastes. And I note that there hadn't been any particular schedules for industry. At what levels would you propose or are there any industries in Wisconsin which have phosphates that would require treatment and reduction?

MR. FRANGOS: I think our general approach would be that where we find those in quantities or concentrations that as a minimum approach the concentrations that you have got in a, quote, standard, unquote, domestic waste, that we would also apply this to any of those sources.

MR. POSTON: In other words, industries would have the same requirement to remove--

MR. FRANGOS: Where there is a significant--

MR. POSTON: Yes, significant--

MR. FRANGOS: --quantity of phosphorus in the wastes that are generated.

MR. POSTON: That is all I have.

MR. STEIN: I don't want to hold this up because I think we have had recommendations from two States where they are thinking in terms of an 80 percent reduction on the basinwide or Statewide basis, and I think if we do this, adopt this or consider this, maybe we can take care of all these problems at one time.

Any other comments or questions?

If not, Mr. Frangos, I would like to thank Mr. Voigt and you for an excellent presentation, and really excellent, because I am convinced now, hearing all four States, that we are going to clean up Lake Michigan. I think, as you know, the Federal-State relations sometimes don't run as smoothly as you might think, and you just have to look at the past record to see some of the colloquys that we have had with Wisconsin in the past.

But on the basis of this, let me say for both of you people, I can understand what you are saying, and I have almost no questions. I can agree with the proposal. I think this is a great thing that has happened in Wisconsin. Of course possibly leading to this, as some of you may know, Tom Frangos used to work in enforcement in one of our regions in New York and we hated to lose him. But now that he is in Wisconsin and you are doing this terrific job, as this report indicates, possibly this is really the way to do business. I am very, very much encouraged with this report from Wisconsin, because I think that the time of misunderstanding of what each one says is in the past, and while we may have differences, they will probably deal with substance.

But as far as I can see, your program and your approach to this and your accomplishments are excellent and I really want to extend my compliments and congratulations to you people there.

MR. FRANGOS: Thank you.

MR. STEIN: You are really doing well.

This will conclude the State presentations.

Now we have a report from the United States Department of Agriculture. It is per Recommendation No. 16:

"The United States Department of Agriculture be requested to submit to the Conferees a report within six months on agricultural programs to prevent pollution from agricultural land use such as siltation and bank stabilization."

Mr. Poston, has that been presented?

MR. POSTON: We received a copy of this report from Mr. Bathurst, of the Department of Agriculture, and he was unable to be here himself. I would ask Mr. Schneider, of my office, to present this report. It is some 15 pages. If there are parts that it is possible to brief down, I would suggest you do that.

Mr. Schneider.

MR. STEIN: Any summary would be appreciated.

STATEMENT OF THE U. S. DEPARTMENT OF AGRICULTURE

Presented by

Robert J. Schneider, FWPCA, Chicago, Illinois

MR. SCHNEIDER: This is a statement of the U. S. Department of Agriculture program to reduce sediment pollution in Lake Michigan--

MR. STEIN: By the way, if you wish, this entire report will appear into the record as if read, without objection.

MR. POSTON: Yes.

MR. STEIN: Would you go ahead, Mr. Schneider, please.

MR. SCHNEIDER: Our environment is now in jeopardy. Pollution in the form of dirty water, foul air, and contaminated soil is deteriorating our surroundings. Sediment, the major threat to clean water, but is defined as solid matter, organic or mineral, that is being moved from its site of origin by water, air, ice, or gravity.

Let's discuss its sources, the damage

and problems it creates and possible solutions to this depredator of our environment.

The greatest volume of pollutants in surface water is the sediment produced by soil erosion. Four billion tons of soil material are translocated each year and carried by flowing water to other locations. About one quarter of this sediment, or 100 million tons, reaches the major streams of the United States annually.

Sources of sediment are sheet erosion by water; gullying by concentrated runoff; streambank erosion; flood erosion by scouring in low areas; erosion from urban, industrial, and other construction sites; roadside erosion from cuts and fills; runoff from surface mining areas; and pollutants from wastes of cities and industries.

Because of the large area involved, agricultural lands supply the greatest amount of sediment to the total load carried by streams. Land in row crops produces the most soil loss. This amount is dependent to a large extent on the crops, tillage practices, slope and climate. While agricultural lands produce much sediment, urban areas under construction produce a disproportionately large share of the sediment load. Many such areas lie in close proximity to major streams and bodies of water, so the massive amounts of sediment are introduced directly into the water. Tilled agricultural lands are scattered and, therefore, much sediment is filtered out before it reaches major water sources. Grass and forest lands, on the average, contribute much less.

Population centers have imposed a tremendous demand on the use of land for urban development, highway construction, industry, parks, airports, shopping centers, golf courses, reservoirs and a host of other uses. These developments are taking more than one and a quarter million acres a year, much of it valuable fruit and vegetable farms.

Since World War II, urban developments have vastly increased the evidence of land erosion and created untold damage. In many of these developments soil conservation is ignored and the result is disasterous. One such urban area in Maryland, of the many thousands in the country, produced 25,000 tons of sediment per square mile annually. Similar cases are occurring around Lake Michigan where construction leaves soil material unprotected.

Erosion damage and silt production along roadsides is likewise a large contributor to the total sediment problem. Roadside erosion defaces landscapes and makes roads dangerous to travel. It results in excessive highway maintenance cost. As much as 350 tons of soil per acre may be lost in a single year. This is many times the maximum loss from a cultivated field.

Another large source of pollution in the United States is the 3.2 million acres of land disturbed by surface mining. Of this figure over two million acres need conservation treatment. Forty percent has eroded enough to form rills and gullies, causing a heavy silt load that may drain into streams and lakes and destroy fish and natural beauty. In many areas surface mining is the major source of water pollution. Disturbing the land surface for mining also destroys wildlife habitat. Nearly two million acres have been destroyed by surface mining alone.

Sand and gravel pits also pose a problem, although not as serious or extensive. It is difficult to establish vegetative cover on these areas. The uncovered soils are, therefore, exposed to wind and water erosion and readily add their sediment to the nearest water course.

Much of the sediment in many streams comes from erosion of the streambank itself. Because stream and river banks are part of the water and sediment conveyance system, soil eroded from these lands is immediately converted to damaging sediment. This is also true of erosion on many lake shores which dump thousands of tons of soil directly into the lakes annually. Sand dunes cause a problem in some areas. They are usually bare of vegetation and are continually shifting and moving, covering roads, woodland areas and waterways.

It is quite likely the damages caused by sediment exceed one-half billion dollars annually. It has a significant and deleterious effect on water quality. Fish are killed by sediment inhibiting breathing and by destroying their habitat through pollution of spawning beds.

Sediment deposited on good land damages crops and may reduce the productivity of the soils.

Deposits in rivers reduce their capacity and may cause flooding or even impair the drainage of adjacent lands. Drainage and irrigation laterals filled with sediment will not carry designed quantities of water and are extremely costly to clean out. In addition, we lose the equivalent of 400,000 acres of good land each year from soil erosion and deterioration. Three times this much land is covered by concrete and asphalt each year. This is an alarming fact when we consider there are less than 500 million acres suitable for cultivation left. The tendency toward more intensive farming results in accelerated erosion.

Storage capacity of artificial reservoirs and natural lakes is depleted by deposition of sediment. This not only affects water supply and hydroelectric power, but flood control as well. Sediment obstructs storm sewers and road ditches. It impedes navigation in harbors and waterways and makes treatment expensive for municipal and industrial water. It causes excessive wear on pumping equipment and irrigation systems. In some situations, sediment in water has clogged underground aquifers. This is extremely important when there is a need to recharge depleted water sources.

The many salts and nutrients adsorbed on sediment particles contribute to the lowering of water quality and the eutrophication of lakes. Phosphates applied as fertilizers have a great affinity for soil particles and are moved into streams only as soil moves. Effectively controlling erosion has a positive effect on controlling phosphate pollution from agricultural fertilizers.

The deposition of sediment on beaches detracts from their use and affects their aesthetic value as well. It also has an influence on the recreation aspects of water for swimming, boating, skiing and fishing.

The problem of dredging and maintaining channels is of great magnitude, both in volume of material moved and the sum spent handling and disposing of the material. It is estimated that the total volume of material dredged and excavated annually from streams, estuaries and harbors exceeds one-half billion cubic yards. In many cases land must be acquired for disposal areas which adds to the cost of equipment and labor.

Effective sediment control from all erosion sources can greatly reduce the volume of sediment to be dredged.

In the past the control of erosion upstream on farms has received the most attention. But if conservation measures were applied everywhere, not just on farms, much of the sediment pollution could be eliminated. It is the unwise land use on all the acres of both urban and rural land that fills reservoirs with sediment, floods basements, cracks foundations, pollutes water, damages roads costing millions of dollars, and damages wildlife and recreation areas indefinitely. With the further concentration of industry and people in the watersheds, the problems of sediment pollution will be intensified unless all segments of society lend their support to effective sediment control programs on all land uses.

The earth now has as much water and soil as it will ever have. What is left needs to be properly treated and maintained. The quality of water and condition of the soil is dependent on the treatment we give the land from the time precipitation falls on the soil until it reaches the lake or ocean. The problems facing us are nothing new, but simply ones that are pyramiding with the sophisticated needs of our society. For solutions, consideration must be given to all segments of our population--industrial, agricultural and urban. Increased pollution need not be the price we pay for an affluent society.

The control of sediment, an absolute necessity for survival, will be extremely beneficial. It will include the reduction in cost of continually removing sediment from channels, harbors, and reservoirs; reduction in damage to wildlife; enhancement of recreation facilities; lower cost in treating domestic and industrial water; less maintenance cost with water distribution systems and highways; and prevention of damage to flood plains. Most important of all is keeping and maintaining the land for future resource use.

Individual citizens control most of the countryside, landscape, and natural resources. Here on privately owned land is where the biggest and most difficult job of resource management is being performed, and where, by necessity, it will have to be performed in the future.

While much has been done to solve soil

and water conservation problems on the Nation's cropland, much remains to be done. More than 25 million acres presently farmed are not suitable for cropland. Another 49 million acres are suitable for only occasional or limited cultivation. A major conservation problem is to convert these acres to vegetative cover or provide the necessary conservation measures on a continuing basis.

Nearly 31 million acres expected to be converted to cropland by 1975 will need establishment of conservation practices.

Of the 437 million acres expected to be used as cropland in 1975, 308 million acres, or 93 percent, has some conservation problem that limits its use; and 272 million acres, or 62 percent, need conservation treatment of some kind. Erosion hazards are the dominant problem on cropland with excess water and unfavorable soil being secondary problems. Conservation practices such as contouring, stripcropping and terracing complemented with vegetation cover and proper rotations would alleviate much of our erosion problems.

Nearly three-fourths of the pasture and range land needs conservation treatment and improvement.

Establishment of cover, improving existing cover, water management and protection from overgrazing are the types of conservation treatment needed.

Private forests and woodlands likewise need treatment on more than half of the 55 million acres in this country. These acres would benefit from protection from fire, insects, disease, and animals. Timber establishment and management would greatly aid erosion control.

Of all the land in the United States, soil erosion is the dominant problem on 59 percent of the land.

The problem of controlling critical sediment sources on nonagricultural land exceeds that of agricultural land because few people are aware of the serious problem or are willing to do anything about it.

Gullying, stream bed and streambank erosion can be controlled by use of structural means such as check dams, drop structures, streambank protection work or gradient control. In addition, floodwater retarding structures, flood control and stream regulating reservoirs and debris basins provide for detention of sediment that would otherwise reach harbors and other downstream improvements.

There are almost one-half million miles of roads that need treatment for the control of erosion. The cost of roadside erosion control varies, but may run from $200 a mile to many times more for a complete job of proper sloping, vegetation, drainage and structures. Road builders, developers, other builders and land users can stop erosion and subsequent deposition by (1) exposing the smallest amount of bare land for the shortest period of time; (2) using temporary ground cover and planting permanent sod quickly; (3) using diversions, sediment basins and terraces to trap sediment; (4) saving and using natural vegetation whenever possible; and (5) following natural topography and land drainage when laying out large developments.

The mining industry, conservation districts, and all levels of government need to work together to put practical principles into surface mining operations. Some excellent work has been done in this respect, but much more needs to be done.

Before mining begins, a plan needs to be worked out to prevent the heavy sediment loads from moving into water courses. While mining is going on, steps need to be taken to control erosion on the side and on haul roads. This would include quick-growing plants for immediate protection and permanent cover when mining is finished. Surface runoff in mining areas needs to be controlled on a watershed basis to fit stream capacities and prevent harmful deposition. In addition, drainage needs to be controlled to maintain adequate cover and keep sediment out of streams. Many lakes could be created on the excavated sites. The proper use of vegetation and water management would control sediment and add beauty and wildlife to the area.

The quantity and quality of water that reaches the estuaries is determined by land use and treatment upstream. We now have the technical know-how and ability to deal with the problem. It is, however, limited by legislation, authorities and resources.

Technical and financial assistance in installing special measures for pollution control should be expanded. Long-term credit and cost-sharing must be increased.

R. J. Schneider

Local government needs further assistance in effective erosion and sediment control programs in urban and industrial developments. This additional financial and technical assistance could aid in the formulation of model regulations. The local organization would develop and maintain the authorities and regulation.

In addition, other authorities to control erosion along highways, streambanks, lakes and strip mined areas are essential. Controlling sediment has long been an objective of the U. S. Department of Agriculture, both in its technical assistance, cost-sharing, research and credit programs.

This Department serves all America, including those in small communities as well as those on the farm and in the city. USDA offers a wide variety of money-saving, health-preserving, comfort-producing opportunities, creating services and technical help for all the people--more than any other government department.

A large share of these services consist of helping individuals, communities, groups, organizations and/or other Federal and State agencies preserve and maintain the soil and water resources of this countr This directly relates to the sediment and pollution of our streams, lakes, ponds, reservoirs and the air we breathe. Uncontrolled sediment may affect every citizen with higher taxes, electricity and water bills, higher food and clothing prices and the necessity for more disaster funds. It is better to practice conservation and hold the soil in place rather than pay to remove sediment and silt from roads, harbors, rivers and reservoirs.

Mr. Chairman, the last five pages of this report deal with some of the ongoing programs and I will just summarize this.

The report goes on to say that much has been done to correct erosion problems. The Department of Agriculture listed Soil Conservation Service, the Agricultural Stabilization and Conservation Service, the Farmers Home Administration, and the Forest Service as their agencies that deal with these programs.

They mention the Small Watershed Program, Public Law 566, as a tool which they use for aiding local organizations in planning and carrying out watershed projects.

It is mentioned here that the National Inventory of Soil and Water Conservation needs is being updated by the Department of Agriculture and it says that current information will provide data for formulating programs, planning conservation work, conducting research, and other purposes by public agencies and private institutions.

In conclusion it says that these agencies all contribute to the overall resource conservation and development in an area. USDA continually endeavors to alleviate and eliminate erosion and resulting sediment and pollutants. We have the know-how to control sediment in all land. Additional effort and legislation to carry out the necessary conservation measures are needed. The wide variety of services and help USDA offers to all the people will enhance man's total environment physically, socially and esthetically, for soil erosion affects every one and shapes the foundation of our environment.

That concludes the statement.

(The following is the document submitted by the United States Department of Agriculture:)

STATEMENT ON U.S. DEPARTMENT OF AGRICULTURE PROGRAM TO REDUCE SEDIMENT POLLUTION IN LAKE MICHIGA

Our environment is now in jeopardy. Pollution in the form of dirty water, foul air, and contaminated soil is deteriorating our surroundings.

Sediment, the major threat to clean water, is defined as solid matter, organic or mineral, that is being moved from its site of origin by water, air, ice or gravity.

Let's discuss its sources, the damage and problems it creates, and possible solutions to this depradator of our environment.

The greatest volume of pollutants in surface water is the sediment produced by soil erosion. Four billion tons of soil material are translocated each year and carried by flowing water to other locations. About one quarter of this sediment, or 100 million tons, reaches the major streams of the United States annually.

R. J. Schneider

Sources of sediment are sheet erosion by water; gullying by concentrated runoff; streambank erosion; flood erosion by scouring in low areas; erosion from urban, industrial and other construction sites; roadside erosion from cuts and fills; runoff from surface mining areas; and pollutants from wastes of cities and industries.

There are presently 1,850 million acres of cropland, forestland and rangeland in the United States. Of this total, approximately 50 percent is subject to erosion. These figures are indicative of the tremendous job that lies ahead.

Because of the large area involved, agricultural lands supply the greatest amount of sediment to the total load carried by streams. Land in row crops produces the most soil loss. This amount is dependent to a large extent on the crops, tillage practices, slope and climate. While agricultural lands produce much sediment, urban areas under construction produce a disproportionately large share of the sediment load. Many such areas lie in close proximity to major streams and bodies of water, so the massive amounts of sediment are introduced directly into the water. Tilled agricultural lands are scattered and, therefore, much sediment is filtered out before it reaches major water sources. Grass and forest lands, on the average, contribute much less.

Population centers have imposed a tremendous demand on the use of land for urban development, highway construction, industry, parks, airports, shopping centers, golf courses, reservoirs and a host of other uses. These developments are taking more than one and a quarter million acres a year,much of it valuable fruit and vegetable farms.

Since World War II, urban developments have vastly increased the evidence of land erosion and created untold damage. In many of these developments soil conservation is ignored and the result is disastrous. One such urban area in Maryland, of the many thousands in the country, produced 25,000 tons of sediment per square mile annually. Similar cases are occurring around Lake Michigan where construction leaves soil material unprotected.

Erosion damage and silt production along roadsides is likewise a large contributor to the total sediment problem. Roadside erosion defaces landscapes and makes roads dangerous to travel. It results in excessive highway maintenance cost. As much as 350 tons of soil per acre may be lost in a single year. This is many times the maximum loss from a cultivated field.

Another large source of pollution in the United States is the 3.2 million acres of land disturbed by surface mining. Of this figure, over two million acres need conservation treatment. Forty percent has eroded enough to form rills and gullies, causing a heavy silt load that may drain into streams and lakes and destroy fish and natural beauty. In many areas surface mining is the major source of water pollution. Disturbing the land surface for mining also destroys wildlife habitat. Nearly two million acres have been destroyed by surface mining alone.

Sand and gravel pits also pose a problem, although not as serious or extensive. It is difficult to establish vegetative cover on these areas. The uncovered soils are, therefore, exposed to wind and water erosion and readily add their sediment to the nearest water course.

Much of the sediment in many streams comes from erosion of the streambank itself. Because stream and river banks are part of the water and sediment conveyance system, soil eroded from these lands is immediately converted to damaging sediment. This is also true of erosion on many lake shores which dump thousands of tons of soil directly into the lakes annually. Sand dunes cause a problem in some areas. They are usually bare of vegetation and are continually shifting and moving, covering roads, woodland areas and waterways.

There is some relationship between polluted air and water. Exposed areas on dunes and mines may be easily eroded by air currents. Soils left unprotected are subject to wind erosion as well as water erosion. Pollution by dust is a serious problem where wind, soil and moisture conditions are conducive to blowing.

It is quite likely the damages caused by sediment exceed one-half billion dollars annually. It has a significant and deleterious effect on water quality.

Fish are killed by sediment inhibiting breathing and by destroying their habitat through pollution of spawning beds.

Sediment deposited on good land damages crops and may reduce the productivity of the soils. Deposits in rivers reduce their capacity and may cause flooding or even impair the drainage of adjacent lands. Drainage and irrigation laterals filled with sediment will not carry designed quantities of water and are extremely costly to clean out. In addition, we lose the equivalent of 400,000 acres of good land each year from soil erosion and deterioration. Three times this much land is covered by concrete and asphalt each year. This is an alarming fact when we consider there are less than 500 million acres suitable for cultivation left. The tendency toward more intensive farming results in accelerated erosion.

Storage capacity of artificial reservoirs and natural lakes is depleted by deposition of sediment. This not only affects water supply and hydroelectric power, but flood control as well. Sediment obstructs storm sewers and road ditches. It impedes navigation in harbors and waterways and makes treatment expensive for municipal and industrial water. It causes excessive wear on pumping equipment and irrigation systems. In some situations, sediment in water has clogged underground aquifers. This is extremely important when there is a need to recharge depleted water sources.

The many salts and nutrients adsorbed on sediment particles contribute to the lowering of water quality and the eutrophication of lakes. Phosphates applied as fertilizers have a great affinity for soil particles and are moved into streams only as soil moves. Effectively controlling erosion has a positive effect on controlling phosphate pollution from agricultural fertilizers.

The deposition of sediment on beaches detracts from their use and affects their aesthetic value as well. It also has an influence on the recreation aspects of water for swimming, boating, skiing and fishing.

The problem of dredging and maintaining channels is of great magnitude, both in volume of material moved and the sum spent handling and disposing of the material. It is estimated that the total volume of material dredged and excavated annually from streams, estuaries and harbors exceeds one-half billion cubic yards. In many cases land must be acquired for disposal areas which adds to the cost of equipment and labor. Effective sediment control from all erosion sources can greatly reduce the volume of sediment to be dredged.

In the past the control of erosion upstream on farms has received the most attention. But if conservation measures were applied everywhere, not just on farms, much of the sediment pollution could be eliminated. It is the unwise land use on all the acres of both urban and rural land that fills reservoirs with sediment, floods basements, cracks foundations, pollutes water, damages roads costing millions of dollars and damages wildlife and recreation areas indefinitely. With the further concentration of industry and people in the watersheds, the problems of sediment pollution will be intensified unless all segments of society lend their support to effective sediment control programs on all land uses.

The earth now has as much water and soil as it will ever have. What is left needs to be properly treated and maintained. The quality of water and condition of the soil is dependent on the treatment we give the land from the time precipitation falls on the soil until it reaches the lake or ocean. The problems facing us are nothing new, but simply ones that are pyramiding with the sophisticated needs of our society. For solutions, consideration must be given to all segments of our population--industrial, agricultural and urban. Increased pollution need not be the price we pay for an affluent society.

The control of sediment, an absolute necessity for survival, will be extremely beneficial. It will include the reduction in cost of continually removing sediment from channels, harbors and reservoirs; reduction in damage to wildlife; enhancement of recreation facilities; lower cost in treating domestic and industrial water; less maintenance cost with water distribution systems and highways; and prevention of damage to flood plains. Most important of all is keeping and maintaining the land for future resource use.

Individual citizens control most of the

countryside, landscape and natural resources. Here on privately owned land is where the biggest and most difficult job of resource management is being performed, and where, by necessity, it will have to be performed in the future.

While much has been done to solve soil and water conservation problems on the Nation's cropland, much remains to be done. More than 25 million acres presently farmed are not suitable for cropland. Another 49 million acres are suitable for only occasional or limited cultivation. A major conservation problem is to convert these acres to vegetative cover or provide the necessary conservation measures on a continuing basis.

Nearly 31 million acres expected to be converted to cropland by 1975 will need establishment of conservation practices.

Of the 437 million acres expected to be used as cropland in 1975, 308 million acres, or 93 percent, has some conservation problem that limits its use; and 272 million acres, or 62 percent, needs conservation treatment of some kind. Erosion hazards are the dominant problem on cropland with excess water and unfavorable soil being secondary problems. Conservation practices such as contouring, stripcropping and terracing complemented with vegetation cover and proper rotations would alleviate much of our erosion problems.

Nearly three-fourths of the pasture and range land needs conservation treatment and improvement. Establishment of cover, improving existing cover, water management and protection from overgrazing are the types of conservation treatment needed.

Private forests and woodlands likewise need treatment on more than half of the 55 million acres in this country. These acres would benefit from protection from fire, insects, disease and animals. Timber establishment and management would greatly aid erosion control.

Of all the land in the United States, soil erosion is the dominant problem on 59 percent of the land.

The problem of controlling critical sediment sources on nonagricultural land exceeds that of agricultural land because few people are aware of the serious problem or are willing to do anything about it.

R. J. Schneider

Gullying, stream bed and streambank erosion can be controlled by use of structural means such as check dams, drop structures, streambank protection work, or gradient control. In addition, flood water retarding structures, flood control and stream regulating reservoirs and debris basins provide for detention of sediment that would otherwise reach harbors and other downstream improvements.

There are almost one-half million miles of roads that need treatment for the control of erosion. The cost of roadside erosion control varies, but may run from $200 a mile to many times more for a complete job of proper sloping, vegetation, drainage and structures. Road builders, developers, other builders and land users can stop erosion and subsequent deposition by (1) exposing the smallest amount of bare land for the shortest period of time; (2) using temporary ground cover and planting permanent sod quickly; (3) using diversions, sediment basins and terraces to trap sediment; (4) saving and using natural vegetation whenever possible; and (5) following natural topography and land drainage when laying out large developments.

R. J. Schneider

The mining industry, conservation districts and all levels of government need to work together to put practical principles into surface mining operations. Some excellent work has been done in this respect, but much more needs to be done.

Before mining begins, a plan needs to be worked out to prevent the heavy sediment loads from moving into water courses. While mining is going on, steps need to be taken to control erosion on the side and on haul roads. This would include quick-growing plants for immediate protection and permanent cover when mining is finished. Surface runoff in mining areas needs to be controlled on a watershed basis to fit stream capacities and prevent harmful deposition. In addition, drainage needs to be controlled to maintain adequate cover and keep sediment out of streams. Many lakes could be created on the excavated sites. The proper use of vegetation and water management would control sediment and add beauty and wildlife to the area.

The quantity and quality of water that reaches the estuaries is determined by land use and treatment upstream. We now have the technical know-how and ability to deal with the problem. It is, however, limited by legislation, authorities and resources.

Technical and financial assistance in installing special measures for pollution control should be expanded. Long-term credit and cost-sharing must be increased.

Local government needs further assistance in effective erosion and sediment control programs in urban and industrial developments. This additional financial and technical assistance could aid in the formulation of model regulations. The local organization would develop and maintain the authorities and regulations.

In addition, other authorities to control erosion along highways, streambanks, lakes and strip mined areas are essential. Controlling sediment has long been an objective of the U. S. Department of Agriculture, both in its technical assistance, cost-sharing, research and credit programs.

This Department serves all America, including those in small communities as well as those on the farm and in the city. USDA offers a wide variety of money-saving, health-preserving, comfort-producing opportunities, creating services and technical help for all the people--more than any other Government Department.

A large share of these services consist of helping individuals, communities, groups, organizations and/or other Federal and State agencies preserve and maintain the soil and water resources of this country. This directly relates to the sediment and pollution of our streams, lakes, ponds, reservoirs and the air we breathe. Uncontrolled sediment may affect every citizen with higher taxes, electricity and water bills, higher food and clothing prices and the necessity for more disaster funds. It is better to practice conservation and hold the soil in place rather than pay to remove sediment and silt from roads, harbors, rivers and reservoirs.

Much has been done to correct erosion problems. The U. S. Department of Agriculture Soil Conservation Service is the technical arm of action with responsibility for soil and water conservation. It provides the assistance of professional conservationists to all land users and decision makers concerning the proper use of the land. This includes planning commissions, land use boards, health officials, county government and others by providing soil information and technical assistance. This assistance, given through Soil Conservation Districts, includes planning conservation programs for the best possible use and treatment of the land and water. Help is provided in the application of practices and combinations of practices for erosion and water control problems, including measures for retarding water flow and reduction of sediment damage in streams and lakes and along highways.

Agricultural Stabilization and Conservation Service provides cost-sharing in urban areas and on farms to landowners in establishing conservation practices on the land. SCS furnishes technical assistance to these Agricultural Conservation Program (ACP) participants in establishing specified measures pursuant to referrals received from ASCS County Committees. In addition, ASCS administers a Cropland Adjustment Program that diverts land to recreation, wildlife habitat, natural beauty, or other uses that control air and water pollution.

Farmers Home Administration administers loans and grants to install or improve rural water supply and service systems, waste disposal systems, recreation facilities, drain farmland and carry out soil conservation measures for which the Soil Conservation Service has provided technical assistance for design and layout. There are also loans for conversion of cropland. These loans help rural groups convert cropland to grazing areas or forest uses that promote conservation of soil and water.

The Forest Service, working with the State forestry agencies, helps plan and install forestry and related measures.

Under the Small Watershed Program, PL-566, SCS gives technical and financial aid to local organizations in planning and carrying out watershed projects. The purpose of a small watershed project is flood prevention, watershed protection, agricultural water management, recreation, municipal and industrial water supply, and fish and wildlife development. These are community projects.

The Soil Conservation Service, through the PL-566 program, pays the cost of engineering services and construction costs for flood prevention and up to 50 percent of the construction costs for irrigation, drainage, recreation, fishing and wildlife developments. All other costs must be paid by local organizations. To help local people carry their share of watershed project costs, Farmers Home Administration makes loans available for developing these projects. Individual farmers may also get ACP cost-share assistance to help establish conservation practices to prevent erosion and runoff in the watershed.

The National Inventory of Soil and Water Conservation Needs is being updated by the U. S. Department of Agriculture in cooperation with other Federal agencies, States and local units of government. Preliminary information from the watershed segment of the inventory shows 618,377 acres of the Lake Michigan drainage basin with floodwater and sediment problems. Urban floodwater and sediment damage is also significant in the basin. In addition, 417,678 acres are being damaged by erosion. A need for water quality control exists in 136 of the 416 watersheds in the basin. This current information will provide data for formulating programs, planning conservation work, conducting research and other purposes by public agencies and private institutions.

The Soil Conservation Service has leadership responsibilities in Resource Conservation and Development Projects. These projects stimulate growth through acceleration of conservation activities and land use adjustments. Federal participation includes technical assistance to help landowners install conservation measures, cost-sharing assistance on certain approved conservation and development measures, and credit to help landowners and local sponsores finance improvements of the soil and water resources. Most USDA agencies may become involved in this total resource development effort which will affect the sediment and deposition in streams and lakes over a multicounty area.

Soil surveys developed by SCS in cooperation with State experiment stations are used increasingly by builders, architects, city planners, and engineers in land use planning in urban fringe areas. Soil maps help planners and engineers determine where subdivisions should go; where pipelines should be routed to avoid unfavorable soils and underground rock formations; how to avoid soils that are wet and subject to flooding; and how to find soils suited for airports, recreation areas and schools. These endeavors have a large bearing on future sediment and erosion potential.

SCS, through its Plant Materials Centers located throughout the country, carries out field trials of different plant materials. Plant materials are developed for use on areas difficult to maintain, such as sand dunes, steep areas along highways and extremely wet or dry areas. Many of these new plant materials are responsible for quelling soil and wind erosion and protecting the soil and water resource.

Several agencies are involved in comprehensive and community resource development which affects erosion and sediment control. SCS provides soil, water, resource, engineering and other kinds of surveys and provides technical assistance in planning resource use, development and conservation. Economic research service provides economic background. Statistical Reporting Service helps in survey planning. Consumer Marketing Service makes payment to State marketing agencies to carry out market service programs. Extension Service provides organizational, educational and technical assistance to help communities analyze and identify community and area problems; establish objectives; and select, develop and use resources to attain them.

Farmers Home Administration makes grants to public bodies for the preparation of comprehensive area plans for water and sewer systems.

Through pooling agreements between ASCS and community groups, costs are shared on community projects for erosion and sediment control.

Agricultural Research Service supplies information on techniques and facilities for processing farm products and industrial use of agricultural commodities. It carries on research programs in soil and water to determine methods and ways of controlling soil and water. Their findings may be adopted by others to alleviate or limit pollution of lakes, streams and air.

The SCS has Departmental leadership in river basin planning activites. This program leads to the delineation of problems related to land resource areas for which project type solutions are necessary.

These agencies all contribute to the overall resource conservation and development in an area.

USDA continually endeavors to alleviate and eliminate erosion and resulting sediment and pollutants. We have the know-how to control sediment on all land. Additional efforts and legislation to carry out the necessary conservation measures are needed. The wide variety of services and help USDA offers to all the people will enhance man's total environment physically, socially and aesthetically, for soil erosion affects every one and shapes the foundation of our environment.

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MR. STEIN: Thank you, Mr. Schneider, for reading that statement.

Maybe this is a good start and an overall view of the national program, but I would ask the Conferees to consider that what we need here is some specifics on how we are going to control agricultural runoff and land runoff, particularly from agriculture into the lake if this is a problem. We know that this comes from construction projects and road building, but that is something we will have to meet and I don't know that it is the charge of this group.

What I would suggest, if the Agriculture

Department says they have the know-how to control sediment on all land, that we set up a group of the Conferees and representatives where they specifically indicate areas where we can put this know-how to work as it is affecting Lake Michigan, with all deference to the great national program or problems we have in this area, how it affects Lake Michigan. We should try to come up with some specifics that we ask the State agriculture departments and the Department of Agriculture to work with us on this and try to get this up. I think we have had the first go-round on this, but I do think before the Conferees can have something to put their teeth into and act on we have to get very much more specific because what we are interested in is stopping the flow of agricultural wastes into Lake Michigan.

Are there any other comments?

MR. KLASSEN: Other than, Mr. Chairman, to add, and I know you are cognizant of this, this wasn't mentioned at all in this report and I don't know that this affects Lake Michigan, it doesn't in Illinois, I am not familiar enough with northern Indiana or Michigan or Wisconsin to know whether runoff from cattle feeding lots is a problem for Lake Michigan. It is definitely a problem that has not been solved and one that the agricultural people quickly brush under the rug when you talk to them about it, but there is something that can be done about this.

But it might not affect Lake Michigan, so I know you are aware of including this in any study.

MR. STEIN: Yes, we are. And surprisingly enough, in various areas of the country where we have got these cattle feeding lots, no one mentioned them as a problem. When we got out to look at them we found out that they were a tremendous problem in these areas.

I think that is a very good suggestion, and when we come up with this group they should look at the extent of the feed lot problem in the Lake Michigan drainage area. I have no way of knowing whether that is or is not a problem up here. But increasingly that has become a significant pollution problem in many areas of the country.

Are there any other comments or questions?

If not, thank you very much, Mr. Schneider.

May we proceed with the status of waste

treatment in Federal installations.

Mr. Poston.

MR. POSTON: I will ask Mr. Gamet to make this statement on Federal installations. And I understand that Captain Shepard of the Great Lakes Naval Training Center may wish to comment also on their particular problems at Great Lakes and possibly Colonel Warner to comment on Fort Sheridan problems.

And Merrill, at an appropriate time you might introduce the two.

MR. GAMET: Will do.

MR. STEIN: Merrill is still here? You know, you have been working in the Government almost as long as I have.

STATEMENT BY MERRILL GAMET
REGIONAL FEDERAL ACTIVITIES COORDINATION
OFFICE OF FACILITIES PROGRAMS
GREAT LAKES REGION, CHICAGO, ILLINOIS

MR. GAMET: Chairman Stein and Conferees, this will constitute a very brief summary of waste treatment and disposal at the Federal installations, with surface water discharges in the Lake Michigan Basin. More detailed information is contained in a status report which has been distributed to the Conferees.

We believe that significant progress has been made by Federal agencies since the Lake Michigan Enforcement Conference was held a year ago in the direction of improvement of waste treatment facilities or planning to divert wastes out of the Lake Michigan Basin. These are briefly as follows:

U. S. COAST GUARD

1. The Chicago Harbor Station was closed permanently on December 15, 1968, thereby eliminating a source of waste to Lake Michigan.

2. The Indiana Harbor and Charlevoix, Michigan Stations have secondary package treatment plants plus chlorination in operation.

3. Plans have been formulated to unman and automate nine Light Stations, thereby eliminating waste discharges.

4. Plans have been made to unman

The Racine, Wisconsin Lifeboat Station.

5. Two Coast Guard Cutters, the SUNDEW, berthed at Charlevoix, Michigan, and the MESQUITE, berthed at Sturgeon Bay, Wisconsin, have waste holding tanks installed with dockside connections to pump to municipal sewers. These are in operation at the present time.

U. S. ARMY

1. Plans are in progress to divert water treatment plant wastes and boiler blowdown to the sanitary sewer system at Fort Sheridan, and ultimately to connect these and the entire sanitary sewer system to the North Shore Sanitary District system for diversion out of the Lake Michigan Basin. I will not discuss these proposed projects further because, as stated, Col. Warner is here from the headquarters of the Fifth U.S. Army and he will have a statement to make.

No plans, to our knowledge, are being made at this time for nutrient removal.

M. Gamet

U. S. NAVY

1. Plans are being developed to divert water treatment plant wastes and boiler blowdown to the sanitary sewer system at the Great Lakes Naval Training Center. Plans are also in progress to divert all wastes either raw or treated from both the main sewage treatment plant and the Green Bay Plant to the North Shore Sanitary District system for discharge out of the Lake Michigan Basin. Five alternatives are under consideration. Again, as Mr. Poston announced, Capt. Shepard is here from the Midwest Division, Naval Facilities Engineering Command, and will present a statement about these projects.

2. No progress can be reported at this time regarding the status of the proposed project to construct a sanitary sewer and pump station to transport wastes from the Naval Reserve Training Center and the S. S. PARLE, located in the Chicago Harbor, to the city of Chicago sewer system.

Present information indicates that the Metropolitan Sanitary District will advertise for bids in order to determine more accurately the total cost of the project. The Navy has allocated $25,000 toward the project cost.

U. S. AIR FORCE

1. Authorization has been granted for design of a contact stabilization package treatment plant plus chlorination, nutrient removal and polishing lagoon at the Empire Air Force Station, (Leelauau County), Michigan. Anticipated completion of project June 1972.

U. S. DEPARTMENT OF THE INTERIOR

The Bureau of Sport Fisheries and Wildlife, Charlevoix National Fish Hatchery, has no plans for waste treatment facilities since lake water is circulated through fish-rearing tanks and is considered to be non-pollutional.

Now, I would like to mention one other

installation about which we have recently obtained information and was inadvertently omitted from this report. This installation is the Jordan River Fish Hatchery at Elmira, Michigan.

It is suspected, and is at least partially borne out by analyses which have recently been made by our Chicago program office, that this facility is polluting the Jordan River. The indications are that the concentrations of nitrogen and phosphorus compounds are in excess of those allowed and, therefore, are in violation of the Michigan intrastate water quality standards.

However, just two or three days ago we received word from the Bureau of Sport Fisheries and Wildlife that they are making plans to install a settling basin or lagoon for treatment in order to comply and that funds are being requested for fiscal year 1971 with anticipated completion during that fiscal year.

(The following is the document submitted by Mr. Gamet:

SURFACE WATER DISCHARGES
from
FEDERAL INSTALLATIONS
in the
LAKE MICHIGAN BASIN

FEBRUARY 1969

Legend:
S - Secondary Waste Discharges
I - Industrial Waste Discharges including filter backwash, boiler blowdown, etc.
P - Persons

A

SURFACE WATER DISCHARGES

FROM FEDERAL INSTALLATIONS IN THE LAKE MI

Installation (Agency & Location)	Waste Type & Volume 1000 GPD	Receiving Stream	Present Treatment	Improvement
ILLINOIS				
U.S.Coast Guard Sta. Chicago Harbor Chicago (Cook Co.)				
U.S. Navy, Great Lakes Naval Training Center Great Lakes (Lake Co.)	S 4,200	L.Mich.	Secondary, Chlorination BOD removal 90% SS removal 90%	1) Additional capacity, equipment, improvement tion system ments, slu system mo
			BOD - 15 mg/l SS - 29 mg/l PO_4 - 30 mg/l	2) Nutrient r
	I 400	L.Mich.	No treatment of water treatment plant filter backwash water and boiler plant blowdown	3) Treatment treatment
U.S. Navy, Naval Reserve Training Center (Armory) Chicago (Cook Co.)	S 8.8	Chicago Harbor (Inner)	Primary (Septic Tank) Chlorination	Connect to mu system
U.S. Army, Fort Sheridan Fort Sheridan, (Lake Co.)	S 542	L.Mich.	Secondary, chlorination BOD - 20 - 30 mg/l SS - 25 - 35 mg/l P - ?	1) Nutrient r connection Shore Sanit
	I 48	L.Mich.	Water treatment plant filter backwash not treated	2) Connect to sewer syst

B

SURFACE WATER DISCHARGES

EDERAL INSTALLATIONS IN THE LAKE MICHIGAN BASIN

nt Treatment	Improvement Needs	Proposed Program for Remedial Facilities	Timetable for Accomplishment (Completion dates)
			Station closed permanently December 15, 1968
Chlorination l 90% 90%	1) Additional settling capacity, plant control equipment, filter improvements, chlorination system improvements, sludge handling system modifications.	1) & 3) Improvement project originally scheduled for funding this fiscal year has been revised to include treatment facilities for water treatment plant filter backwash waste and heating plant boiler blowdown. Project now scheduled for Fiscal Year 1970.	Evaluation now being made of 5 alternatives re: improvements to existing facilities and/or connect to North Shore Sanitary District system. Decision expected by April 1969. Project completion by 1/71 for (1) & (3), and 12/72 for (2) of remedial facilities.
mg/l mg/l mg/l	2) Nutrient reduction.	2) Project for nutrient removal in study stage; or connection to North Shore Sanitary District system.	
nt of water treat- : filter backwash boiler plant blowdown	3) Treatment in main waste treatment plant.		
Septic Tank) Chlorina-	Connect to municipal system	Project to construct sewer to serve State-owned Armory, SS PARLE and waste collection from pleasure craft in Monroe Street Harbor.	Funding of project not determined. No Federal funds granted at this time. San. Dist. will advertise for bids to determine total cost.
, chlorination - 30 mg/l - 35 mg/l	1) Nutrient removal or connection to North Shore Sanitary District	Planning in progress to connect to NSSD for disposal out of L.Mich. Basin .	Funding to be requested for FY 71, Completion 7/72.
atment plant ckwash not treated	2) Connect to sanitary sewer system.	Boiler blowdown, filter backwash & sedimentation basin sludge to be pumped into sanitary sewer.	Funded FY 1969 Completion July 1969

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SURFACE WATER DISCHARGES

FROM FEDERAL INSTALLATIONS IN THE LAKE MICHIGA

Installation (Agency & Location)	Waste Type & Volume 1000 GPD	Receiving Stream	Present Treatment Effluent Characteristics	Improvement Needs
INDIANA				
U.S.Coast Guard Indiana Harbor East Brw. C.G. Station East Chicago (Lake County)	S 0.45	L.Mich.	Secondary, Chlorination BOD - 30 mg/l 95% reduction SS - 92% reduction Total P - 20 mg/l 65% reduction Sol. P - 18 mg/l 52% reduction	None
Nike C.G. Site 32 Chesterton (Porter Co.)	S 7.1	Dunes Cr. to Little Calumet R.	Secondary, chlorination BOD - 90% reduction SS - P - ?	None
Nike C.G. Site 45 Gary (Lake Co.)	S 3.0	Ditch Trib. to Grand Calumet R.	Secondary, chlorination BOD - 90% reduction SS - P - ?	None
Nike C.G. Site 47 Wheeler (Porter Co.P	S 8.0	Ditch Trib. to Burns Ditch	Secondary, chlorination BOD - 90% reduction SS - P - ?	None

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ATER DISCHARGES

ONS IN THE LAKE MICHIGAN BASIN

s	Improvement Needs	Proposed Program for Remedial Facilities	Timetable for Accomplishment (Completion dates
	None	None	Operative
	None	None	
	None	None	
	None	None	

A

SURFACE WATER DIS

FROM FEDERAL INSTALLATIONS IN T

Installation (Agency & Location)	Waste Type & Volume 1000 GPD	Receiving Stream	Present Treatment Effluent Characteristics	Im
MICHIGAN				
U.S. Air Force Empire Air Force Station (Leelanau Co.)	S 20.0	-	Present septic tank - subsurface disposal system is inadequate; overloading of system has resulted in the discharge of effluent to the ground surface.	New t provi chlor reduc
U.S. Coast Guard Charlevoix Station, Charlevoix (Charlevoix Co.)	S 2.5	Pine River	Secondary, chlorination Effl. D.O. 4.0 mg/l BOD - ? SS - ? P - ?	None plan cont Diff ered trai plan 25% Faci for
Grays Reef Lt. Station Cross Village (Emmet Co.)	S 0.35	L.Mich.	None	Seco

B

SURFACE WATER DISCHARGES

RAL INSTALLATIONS IN THE LAKE MICHIGAN BASIN

Treatment Characteristics	Improvement Needs	Proposed Program for Remedial Facilities	Timetable for Accomplishment (Completion dates)
ic tank - isposal system is overloading of esulted in the effluent to the ce.	New treatment facilities to provide secondary treatment, chlorination and nutrient reduction.	Present plan consists of construction to a contact stabilization plant, chlorination, nutrient removal and polishing lagoon. Some evaluation still required to finalize plan. A project document has been prepared with a cost of $99,000.	Funds have been requested for construction in FY 70 Project now authorized for design. Anticipated completion 6/72.
hlorination 4.0 mg/l	None other than improved plant operation and control. Difficulties are encountered with inadequately trained operators and plant operating at about 25% of design capacity. Facilities not available for BOD and P analyses.	Coast Guard will request assistance from municipality on chemical analyses.	Completed
	Secondary, chlorination	Coast Guard plans to automate and unman the station, thereby eliminating any further discharge. Schedules are being set back due to inability to obtain electronic equipment, such as signal detectors and monitoring black boxes.	1975

A

SURFACE WATER DISCHARGES

FROM FEDERAL INSTALLATIONS IN THE LAKE MICHIGAN B

Installation (Agency & Location)	Waste Type & Volume 1000 GPD	Receiving Stream	Present Treatment Effluent Characteristics	Improvement Needs
MICHIGAN, Cont'd.				
Lansing Shoal Lt.Sta. (Machinac Co.)	S 0.35	L.Mich.	None	Secondary, chlorination
Menominee Pierhead Lt. Station (Menominee Co.)	S 0.2	Green Bay	None	Secondary, chlorination
Minneapolis Shoal Lt. Sta., Escanaba (Menominee Co.)	S 0.35	Green Bay	None	Secondary, chlorination
U.S. Coast Guard North Manitou Shoal Lt. Station (Leelanau Co.)	S 0.35	L.Mich.	None	Secondary, chlorination
White Shoal Lt.Station (Leelanau Co.)	S 0.35	L.Mich.	None	Secondary, chlorination
U.S. Coast Guard Cutter SUNDEW, Charlevoix Harbor (Charlevoix Co.)	47 P	Operates in L.Mich.	Holding tank	None

B

ER DISCHARGES

S IN THE LAKE MICHIGAN BASIN

Improvement Needs	Proposed Program for Remedial Facilities	Timetable for Accomplishment (Completion dates)
Secondary, chlorination	Coast Guard plans to automate and unman the station, thereby eliminating any further discharge. Schedules are being set back due to inability to obtain electronic equipment, such as signal detectors and monitoring black boxes.	1977
Secondary, chlorination	"	1976
Secondary, chlorination	"	1975
Secondary, chlorination	"	1972
Secondary, chlorination	"	1978
None		Holding tank with connection to Charlevoix city sewe installed in 1968. Now operative and in compliance.

A

SURFACE WATER DISCHARGE

FROM FEDERAL INSTALLATIONS IN THE LAK

Installation (Agency & Location)	Waste Type & Volume 1000 GPD	Receiving Stream	Present Treatment Effluent Characteristics	Improvem
MICHIGAN, Cont'd.				
U.S.Dept. of Interior Bureau of Sports Fisheries & Wildlife Charlevoix National Fish Hatchery (Charlevoix Co.)	800.0	L.Mich.	None	800,000 GPD tanks is no
WISCONSIN				
U.S. Coast Guard Racine C.G. Station Racine (Racine Co.)	S 1.0 S 0.3	Root R. "	Primary (septic tank) None	Secondary,
Green Bay Harbor Ent. Lt.Station Green Bay (Brown Co.)	S 0.4	Green Bay	None	Secondary,
Kewaunee Pierhead Lt. Sta., Kewaunee (Kewaunee Co.	S 0.4	L.Mich.	None	Secondary,
Manitowoc Breakwater Lt. Station Manitowoc (Manitowoc Co.)	0.05	L.Mich.	None	Secondary,
U.S. Coast Guard Cutter MESQUITE Sturgeon Bay, Door Co.	47 P	Operates in L.Mich.	Holding tank	None

B

SURFACE WATER DISCHARGES

AL INSTALLATIONS IN THE LAKE MICHIGAN BASIN

reatment Characteristics	Improvement Needs	Proposed Program for Remedial Facilities	Timetable for Accomplishment (Completion dates)
	800,000 GPD of lake water circulated through fish-rearing tanks is non-pollutional and requires no treatment.		-
ic tank)	Secondary, chlorination	Coast Guard plans to unman the station	1970
	Secondary, chlorination	Coast Guard plans to unman and automate the station, thereby eliminating the discharge.	1973
	Secondary, chlorination	"	1977
	Secondary, chlorination	"	1973
	None	None	Holding tank with connection to Sturgeon Bay city sewer installed in 1968. Now operative and in compliance.

MR. GAMET: This concludes my brief statement, and if there are no comments or questions, I would like to call upon Col. Warner--

MR. STEIN: Let's just wait a minute, please.

Are there any comments or questions of Mr. Gamet?

MR. PURDY: Yes, sir. Mr. Chairman, could we have the results of the testing made by the FWPCA at the Jordan River fish hatchery? We have had a lot of local interest expressed.

MR. GAMET: I don't have them with me here.

MR. PURDY: Yes, but I mean--

MR. GAMET: I am sure they can be made available. They have been submitted to the Bureau of Sport Fisheries and Wildlife, who requested this study.

MR. STEIN: Why can't we make them available to the States?

MR. POSTON: We can.

MR. GAMET: I am sure we can.

MR. STEIN: O. K.

MR. PURDY: Yes.

MR. STEIN: That will be done.

Are there any other comments or questions? If not, thank you.

MR. GAMET: Col. Warner.

STATEMENT BY COLONEL E. B. WARNER
CHIEF, ENGINEERING DIVISION
FIFTH U. S. ARMY, FORT SHERIDAN, ILLINOIS

COL. WARNER: Thank you, Mr. Gamet.

Chairman Stein, Mr. Poston and Conferees.

Mr. Gamet has essentially outlined our problems, but I might supplement those to a modest degree by a little more accuracy on our exact status at the moment.

In the Fifth United States Army we have four facilities which fall under the purview of the Conference, i.e. or contributing to pollution of the lake. These are four NIKE sites in the northern Indiana area, the backwash from the water treatment plant at Fort Sheridan, the blowdown and steam plant at Fort Sheridan, and last the sewage plant itself at Fort Sheridan. As Mr. Gamet indicated, only three of these NIKE sites remain. We have closed one down. In addition, one other site has been significantly reduced in scope so that it deals in purely administrative matters now, so it is much smaller in scope than it was before. The other two have populations less than 100.

These sites came under the purview of the Conference in December on the lower Lake Michigan area, and at that time sites, to the best of our knowledge, were considered to be in full compliance with the recommendations of that body. We, therefore, concluded that they meet the requirements of this group.

The border plant blowdown at Fort Sheridan is a very simple project, it is a matter of a 30-foot sewer line to connect to the Fort Sheridan sewage disposal system. We are all geared up to accomplish this as soon as the ground thaws and we can get to it. It is within the purview of our authority; we have the funds.

The third problem is the backwash water from the Fort Sheridan water treatment plant. We currently have a combination rehabilitation and new construction project which we are trying to implement at the water plant. The repair portion of this project is within our funding and approval authority and we are proceeding with this portion of the work. The portion which will correct the backwash water discharged into Lake Michigan, unfortunately, is in the new construction portion of the project, which does require congressional approval. We had it programmed for FY1970 and it was eliminated from the program by higher headquarters. We have reprogrammed it for FY 1971, and if it is approved in this program we will be able to accomplish the work in 1972. This will be one year later than the desired deadline placed by the body, the Conferees.

The Fort Sheridan sewage plant, our solution to this, of course, is to discontinue the plant and divert all Fort Sheridan sewage to the North Shore Sanitary District. This project also is included in our FY1971 MCA construction program (Military Construction Army) which does require congressional approval. If approved by Congress and funded, we will expect to get the funds in time to meet the December 1972 deadline placed by the Conference on elimination of nutrients from the lake.

That concludes my report.

MR. STEIN: Thank you, Col. Warner.

Are there any comments or questions?

Mr. Klassen.

MR. KLASSEN: I am particularly interested in Fort Sheridan, Colonel. Are you putting all your eggs in one basket or are there alternatives if Congress does not approve the idea of dismantling and diverting everything to the North Shore Sanitary District? What other alternate plans are you considering, if any?

COL. WARNER: Insofar as nutrient removal, Mr. Klassen, we have not--we have our eggs in a single basket to divert, yes, sir.

MR. KLASSEN: O. K.

COL. WARNER: Now, to shift gears and meet the 1972 deadline, we would not be able to--December 1972 on nutrients, that would involve treatment. We presently at Fort Sheridan have secondary treatment with chlorination, but this falls short of the nutrient removal objective.

MR. KLASSEN: I would say we look very favorably upon this idea of diverting it, and I hope that Congress approves this.

MR. STEIN: Do you have an agreement with the North Shore District to take your wastes if the Congress approves it?

COL. WARNER: Yes, sir.

MR. STEIN: All right.

COL. WARNER: There are several details, I presume, that are to be ironed out, but in principal we approached them several years ago on this concept.

MR. STEIN: I just have one other comment that I was interested in a remark of yours. You said that one NIKE site became much more limited in scope since it was devoted to purely administrative functions. The last one I ever would expect to repeal Parkinson's Law would be the Army, because we can't do it in Interior. My view is, my experience is, when we devote anything to administrative functions we increase rather than diminish the scope.

COL. WARNER: Well, the administrative functions were there before, Murray. We took away the operational portion of that site. No administrative functions were eliminated, I assure you.

(Laughter.)

MR. STEIN: Right. Thank you.

MR. KLASSEN: At the risk of just another minute here, I read in the Chicago paper last night in the letters to the editor--and I don't know who this lady is--but it is going to make her very happy when she reads this, because, and I quote, she says, "Why doesn't my money go for cleaning up the water I swim in? I cannot sanction giving the military half of my money to find another way to commit suicide for me."

So this probably will answer her question.

(Laughter.)

MR. STEIN: We have another one.

MR. POSTON: Capt.Shepard is going to describe the waste treatment at the Great Lakes Naval Training Center.

STATEMENT BY CAPTAIN G. R. SHEPARD
C.O. MIDWEST DIVISION NAVAL FACILITIES
ENGINEERING COMMAND, GREAT LAKES, ILLINOIS

CAPT. SHEPARD: Mr. Chairman, Conferees.

I appreciate the opportunity to present

on behalf of Admiral Renken, Commandant of the Ninth Naval District, an up-date on the Navy's statement as presented to the Four-State Conference about one year ago.

To review, the Naval Training Center has two sewage treatment plants, both of which provide secondary treatment. One discharges effluent to the Skokie Ditch, the other into Lake Michigan. A military construction project has been requested and is currently programmed for fiscal year 1971. This project provides for repair and improvements to the existing plant which now discharges the effluent into Lake Michigan. Additionally, this project includes collection and treatment of wastes from the water treatment plant and from the heating plant, which presently, on an independent basis, discharge into Lake Michigan.

We are also studying different plans of removing the entire secondary effluent from the main side plant from Lake Michigan. The concepts we are adopting here are similar to that which the North Shore Sanitary District has developed for the surrounding communities. These choices are:

A. To pump raw sewage into the North Shore Sanitary District system.

B. To pump the treated effluent from the main side plant into the North Shore Sanitary District system.

And C. To provide tertiary treatment to the effluent from the main side plant and then pump directly by our own route to the Des Plaines River.

The ultimate choice would be based primarily upon the economics of the comparison.

This study should be completed on 31 May 1969, at which time a project will be prepared and submitted for inclusion as a line item in the fiscal year 1972 military construction program.

At present--and now I am going to move into the ship area as it affects Lake Michigan--there are four operating ships and two reserve submarines in the Lake Michigan area. One operating ship is the USS PARLE, DE-708, home ported at the Naval Reserve Armory, Chicago. A sewage disposal system costing $170,000, for the ship has been funded and should be installed by April of this year, in about two months. The Navy also has provided $25,000 as its share of the cost to construct a sewage collection system on the Monroe Street Harbor Pier. This is the project that Mr. Gamet stated is having some funding difficulties at the present time from the other contributors.

The second operating ship is the USS HAVRE, PCE-877, home ported at the Naval Training Center, Great Lakes. The waste from this ship currently discharges into the Training Center's sanitary system.

The third operating unit is the USS PORTAGE, PCE-902, home ported in Milwaukee. Funds have been requested to provide a ship collection system and it is expected that this project will be funded with Fiscal Year 1970 funds. The project for the shore collection sewage system has been submitted also for Fiscal Year 1970 funding. We presently are in Fiscal Year 1970.

The fourth operating unit is the USS ELY, PCE-880, home ported at Sheboygan. Funds have been requested to provide a ship collection system and it is expected that this project will be funded with Fiscal Year 1970 funds. The project for the shore collection system will be submitted for fiscal year 1971 funding.

There are two reserve submarines, USS SILVERSIDES, AGSS-236, home ported in Chicago, and the USS COBIA, AGSS-245 home ported in Milwaukee. There are no provisions for sewage disposal for these craft, inasmuch as they pose no problem because they are non-operating. They are continually alongside the pier where shoreside facilities are available.

I think it will be of interest to this group to be informed regarding the latest action that the Navy has taken with regard to shipboard sewage disposal systems. Quite a bit of research has been done on this, and I will read this statement.

A complete sewage disposal unit has been installed on the USS FISK, which is a destroyer which has been operating on the East Coast. It has been operating for over one year. The results of this prototype installation have been excellent as far as the principle of operation is concerned. However, there have been numerous mechanical problems which have rendered the reliability of the operation somewhat questionable. However, changes in design are being incorporated and it still remains the best hope for a complete underway sewage system. This, of course, will have application to craft and ships operating on the Great Lakes, particularly on Lake Michigan here, when they are out of port.

The Navy's ships system command is buying eight of these revised units and will install them on a subtender for furtner testing. We expect that this testing will begin in 1970. The ship systems command also is embarked on a cause and effect study to be completed in May to determine the most advantageous method of handling wastes. In this case we are speaking of this for larger vessels, and the comparison is whether it should be by onboard disposal or by holding tanks. We will have the results from this about midyear, and following the conclusions which will be derived, an application for appropriations for conversions of various Navy ships will be submitted.

Mr. Chairman, this concludes my presentation.

(The following is the document submitted by Capt. Shepard:)

CAPTAIN SHEPARD'S STATEMENT

FOUR-STATE CONFERENCE

25 February 1969

Mr. Chairman, Conferees, ladies and gentlemen.

I appreciate the opportunity to present on behalf of Admiral H. A. Renken, Commandant of the Ninth Naval District, an up-date of the Navy's statement as presented at the Four-State Conference held on 31 January 1968.

To review, the Naval Training Center, Great Lakes, has two sewage treatment plants, both of which provide secondary treatment. One discharges effluent to the Skokie Ditch, the other discharges effluent into Lake Michigan. A military construction project has been requested and is currently programmed for Fiscal Year 1971. This provides for improvements to the existing plant which now discharges effluent into Lake Michigan.

Additionally, this project includes collection and treatment of wastes from the water treatment and heating plants presently discharging into Lake Michigan.

We are also studying different plans of removing the entire secondary effluent from the main side plant from Lake Michigan. These include:

A. Pumping raw sewage into the North Shore Sanitary District system.

B. Pumping the treated effluent from the main side plant into the North Shore Sanitary District system.

C. Providing tertiary treatment to the effluent from the main side plant and pumping to the Des Plaines River.

This study should be completed by 31 May 1969 at which time a project will be prepared and submitted for inclusion as a line item in the 1972 military construction program.

At present there are four operating ships and two reserve submarines in the Lake Michigan area. One operating ship is the USS PARLE, DE-708, home ported at the Naval Reserve Armory, Chicago. A sewage disposal system costing $170,000, for the ship has been funded and should be installed by April 1969. Twenty-five thousand dollars has been provided as the Navy's share of the cost to construct a sewage collection system on the Monroe Street Harbor Pier.

The second operating ship is the USS HAVRE, PCE-877, home ported at the Naval Training Center, Great Lakes. The waste from this ship currently discharges into the Center's sanitary system.

The third operating unit is the USS PORTAGE, PCE-902, home ported at Milwaukee. Funds have been requested to provide a ship collection system and it is expected that this project will be funded with fiscal year 1970 funds. The project for the shore collection sewage system has been submitted for fiscal year 1970 funding.

The fourth operating unit is the USS ELY, PCE-880, home ported at Sheboygan. Funds have been requested to provide a ship collection system and it is expected that this project will be funded with fiscal year 1970 funds. The project for the shore collection sewage system will be submitted for fiscal year 1971 funding.

The two reserve submarines, USS SILVERSIDES, AGSS-236, home ported in Chicago, and the USS COBIA, AGSS-245, home ported in Milwaukee, have no provision for sewage disposal. However, they pose no problem as they are non-operating and pier side facilities are available.

In conclusion I would like to state that it has been and it will continue to be our policy to cooperate with the FWPCA, State and local government agencies with regard to water pollution matters.

Copies of this presentation have been made available for the record.

- - -

MR. STEIN: What do you mean by onboard disposal or holding tanks?

CAPT. SHEPARD: Well, the onboard disposal that I referred to would be a device, primarily an incineration device.

MR. STEIN: Oh, I see.

CAPT. SHEPARD: Yes, sir.

MR. STEIN: All right. In other words,

either alternative would meet the Conference recommendations that no waste is being discharged overboard, treated or untreated?

CAPT. SHEPARD: Yes, sir.

MR. STEIN: All right.

CAPT. SHEPARD: The onboard disposal system would be the same thing that I referred to as being aboard the FISK and being tested.

MR. STEIN: All right. Thank you very much.

Are there any other questions or comments?

If not, thank you very much, Captain.

We will now go on. And the reason we are pursuing this so hard, and I hope you will bear with us, we are having only, hopefully, one intermission. We will try to hit two more items, just to tell you what is going on, so we can try to get through today and enable the Conferees to meet their other commitments.

We will take "uniform regulations to control wastes from watercraft," and this is Recommendation No. 13 of the Conferees. I believe Mr. Klassen has that.

Mr. Klassen.

STATEMENT OF CLARENCE KLASSEN, CHAIRMAN COMMITTEE ON UNIFORM RULES AND REGULATIONS TO CONTROL WASTES FROM WATERCRAFT

(REGULATION 13)

MR. KLASSEN: Mr. Chairman, the Committee met and recommended a unanimously-approved set of rules and regulations or legislation, whichever it takes. The Conferees approved this March 2, 1968.

Very briefly, this provides that no marine toilet on any watercraft discharge wastes directly or indirectly unless the sewage has been rendered non-pollutional by passage through a device approved by the Department or whatever agency it is in the State. And the other amplifies this.

The control devices that are acceptable for the purposes of this act are holding tank, incinerating devices, ashes to be disposed of, I am sure, not in the water, or any other device determined by the Department or agency to be effective in preventing pollution from marine toilets. This act as suggested here has bee passed by the State of Michigan. The Illinois Sanitary Water Board adopted these as rules and regulations effective--the date that it was adopted was July 2, effective January 1970. Michigan also adopted this. Wisconsin, we have heard, has this proposal ready, I understand, to send to the Legislature. And Indiana, we have heard this morning, has the legislation necessary, passed both Houses and on the desk of the Governor for approval.

There is one point. Mr. Miller, I don't know whether I misunderstood you or not. The effective date of this as agreed upon by all of the States was January 1, 1970, and I realize you cannot commit a State Legislature, but did I understand you correctly that the effective date was January 1971 instead of 1970?

MR. POOLE: That is correct. That was a concession to include cargo-carrying vessels as well as pleasure craft. That covers all vessels.

MR. KLASSEN: I might say also in that respect, the uniform act that was recommended and approved by the Conferees excepted vessels engaged in interstate commerce and vessels of foreign registry.

PROPOSED ACT
(or Rules and Regulations)
FOR THE DISPOSAL OF SEWAGE FROM MARINE TOILETS

Developed by Subcommittee on "Wastes from Watercraft" - Lake Michigan - Four State Enforcement Conference. Approved by All Conferees, March 2, 1968.

* * *

AN ACT (or Rules and Regulations) to regulate the disposal of sewage from watercraft.

1.0 DEFINITIONS

For purposes of this Act (or Rules and Regulations), unless the context clearly requires a different meaning:

1.1 "Watercraft" includes every description of watercraft, other than a seaplane, on the water, used or capable of being used as a means of transportation on water, except vessels engaged in Interstate Commerce and vessels of foreign registry.

1.2 "Sewage" means all human body wastes.

1.3 "Litter" means bottles, glass, crockery, cans, scrap metal, junk, paper, garbage, rubbish, plastic, or similar refuse discarded as no longer useful or useable (or use definition in own state boating law).

1.4 "Marine Toilet" means any toilet on or within any watercraft.

1.5 "Waters of the State" means all of the waterways on which watercraft shall be used or operated (or state definition).

1.6 "Person" means an individual, partnership, firm, corporation, association, or other entity (or state definition).

1.7 "Owner" means the person who has lawful possession of a boat by virtue of legal title or equitable interest therein which entitles him to such possession (or state definition).

1.8 "Department" means the ....(name of the State agency which shall administer this Act).

2.0 LITTERING OR POLLUTING WATER - RESTRICTIONS

Restrictions on placing, throwing, depositing or discharging litter into waters of this State are contained in .... (refer to appropriate State Act or Rules and Regulations).

3.0 MARINE TOILETS - RESTRICTIONS

3.1 No marine toilet on any watercraft used or operated upon waters of this State shall be operated so as to discharge sewage into said waters, directly or indirectly, unless the sewage has been rendered non-pollutional by passage through a device approved by the Department (or .... name of State Water Pollution Control Agency if Department and said agency are not the same).

3.2 No person owning or operating a watercraft with a marine toilet shall use, or permit the use of, such toilet on the waters of this State, unless the toilet is equipped with facilities that will treat, hold, incinerate or otherwise handle sewage in a manner capable of preventing water pollution.

3.3 No person shall dispose of sewage, accumulated in a holding tank or any other container on a watercraft, in such manner that the sewage reaches or may reach the waters of this State, except through a sewage disposal facility approved by the Department (or .... name of State Water Pollution Control Agency if Department and said agency are not the same).

4.0 MARINE TOILETS - POLLUTION CONTROL DEVICES

4.1 After the effective date of this Act, every marine toilet on watercraft used or operated upon waters of this State shall be equipped with a pollution control device in operating condition approved by the Department (or .... name of State Water Pollution Control Agency if Department and said agency are not the same).

4.2 Pollution control devices that are acceptable for purposes of this Act are:

4.21 Holding tanks which retain toilet wastes for proper disposal pursuant to Rule 3.3.

4.22 Incinerating devices which will reduce to ash all sewage and toilet wastes produced on the watercraft. Ash is to be disposed of on shore - not to waters of the State.

4.23 Any other device determined by the Department (or agency) to be effective in preventing pollution from marine toilets.

5.0 ENFORCEMENT

(Refer to enforcement authority of State Boating Act). (or Pollution Control Act).

6.0 EFFECTIVE DATE

The provisions of this Act with reference to requiring watercraft with toilet facilities to be equipped with pollution control devices shall take effect January 1, 1970.

The Illinois Sanitary Water Board did not include that. They are including all vessels and thought that if someone wanted to question their jurisdiction, this is something that they could do.

But other than this date by Indiana, and hopefully Wisconsin will have the 1970, this constitutes our report, Mr. Chairman, I think a real step forward.

MR. STEIN: So do I.

Are there any comments or questions on this?

By the way, I think this is one of the real accomplishments of the Conferees—to get uniform boat control legislation for control of wastes from the boats on Lake Michigan. I think the Conferees have or should be given the credit of these four States for doing this. I do think that they set a precedent, because I think the Lake Erie States have followed suit and they have adopted about the same regulations. But the Lake Michigan States were one of the first.

And Mr. Klassen, I am glad to see that you act uniformly all the way. You are not just picking on us on jurisdiction; you are ready to take this jurisdiction question on on all the fronts.

Thank you.

MR. KLASSEN: We have not accepted any jurisdictional questions that haven't been offered to us. (Laughter.)

MR. STEIN: Right.

You know, that is my philosophy too. I always accept the full jurisdiction. I figure if anyone is going to cut us down, let the Court do it.

All right, now we go on. The next one will be nuclear discharges and thermal pollution, report of the Committee, and this deals with Recommendation No. 10.

Mr. Poston, who is handling that?

MR. POSTON: Mr. Kittrell is the Chairman of this Committee and he will give a summary of his report.

Mr. Kittrell.

STATEMENT OF F. W. KITTRELL, CHAIRMAN
COMMITTEE ON NUCLEAR POWER PLANT WASTE DISPOSAL
(RECOMMENDATION 10)

MR. KITTRELL: Gentlemen, our Committee came up with a 50-page, typewritten, single-spaced report. I had planned to read that today, but at the urgent plea of several of the Conferees I am merely going to read the introduction, the summary and conclusions of that report. I would like to enter the full report in the record.

MR. STEIN: The report will be included in the record as if read without objection.

MR. KITTRELL: Introduction.

A Conference on pollution of Lake Michigan and its tributary basin (Wisconsin-Illinois-Indiana-Michigan), requested by Governor Otto Kerner of Illinois and called by Secretary of the Interior, Stuart L. Udall, was held in Chicago, Illinois, on January 31, February 1-2, February 5-7, March 7-8,and March 12, 1968.

Among problems discussed by the Conferees was the disposal of waste radioactive material and heat from nuclear power plants scheduled to be located on the shores of Lake Michigan within the next five years. They concluded that insufficient information was available to them at that time to judge the potential effects of these wastes on water quality of Lake Michigan.

The Conferees tenth recommendation, among a total of twenty-six, was:

"The States and the Department of the Interior will appoint members of a special committee on nuclear discharges and the thermal pollution aspects of power plants and reactors. The committee will meet with representatives of the Atomic Energy Commission and other interested parties to develop guidelines for pollution control from nuclear power plants. The committee is to pay special attention to thermal discharges which affect the aquatic life environment of the lake. Representatives of the committee will be available to appear before any Federal or State agency considering approval of a permit for such power plants and reactors."

Members of the committee appointed by the Conferees are:

F. W. Kittrell, Chairman, Public Health Engineer, Federal Water Pollution Control Administration;

C. T. Blomgren, Sanitary Engineer, Illinois State Sanitary Water Board;

L. E. Stratton, Sanitary Engineer, Illinois State Sanitary Water Board;

H. C. Briggs, Sanitary Engineer, Indiana State Board of Health;

J. R. McKersie, Sanitary Engineer, Wisconsin Department of Natural Resources;

J. G. Robinson, Aquatic Biologist, Michigan Water Resources Commission.

Two members of the Committee, Messrs. Briggs and Stratton, have specialized in radiological health. A third, Mr. Robinson, has specialized in aquatic biology. The other three members have had general experience in sanitary engineering and water resources. Clifford Risley, Jr., Chemist, FWPCA, served as non-voting Secretary of the Committee, with W. L. Abbott, Chemist, as his alternate.

The Committee first met, for organizational purposes, on May 27, 1968. It has met in seven two-day and one one-day work sessions since that time.

Valuable contributions have been made by the following agencies, which provided speakers on nuclear power plants and on effects and control of their wastes:

Atomic Energy Commission, Chicago Operations Office;

Commonwealth Edison Company, Chicago Office;

Federal Water Pollution Control Administration, Division of Technical Services;

U. S. Public Health Service, Nuclear Facilities Section.

The Atomic Energy Commission and Public Health Service speakers dealt primarily with radioactive wastes. The Commonwealth Edison speakers presented the results of a single field study of thermal wastes from the company's Waukegan fossil fuel plant that included temperature and biological effects on the lake, and described plans for disposal of wastes from the company's Zion nuclear power plant. FWPCA representatives provided information on heat losses from power plants, effects of

F. W. Kittrell

thermal discharges on aquatic life, and consultation on radiological wastes.

Committee members also have discussed the problems involved with knowledgeable individuals, attended National meetings on thermal pollution and reviewed much literature on the subject.

Although isolated cases of thermal pollution have been recognized for many years, only recently has concern over the problem become widespread. This concern has developed because of the increase in thermal power production, which is doubling approximately every ten years, using both nuclear and fossil fuel, and because of the increasing capacity of individual power plants.

Because of relatively limited attention to thermal pollution in the past, there are few experts in the disposal of waste heat and many gaps in knowledge of behavior of waste heat in receiving waters, of its effects on water quality and uses, and of the most efficient and economical methods of disposal without damage to the aquatic environment. For example, methods of calculating the patterns that will be assumed in lake waters by heated water discharges, and the rates of cooling that may be anticipated in the receiving waters are in the developmental stage. Much additional research will be necessary before it will be possible to predict with assurance what heating water will do when discharged to a lake.

Liquid radioactive wastes, on the other hand, have received a great deal of publicity and attention, and means for the effective treatment and acceptable disposal of them are well known. Of all the radionuclides that are most likely to be constituents of the liquid wastes, only tritium is not directly amenable to removal by accepted methods of treatment such as evaporation or demineralization. This is because tritium is a "heavy" hydrogen atom, and exists therefore as an integral part of the water molecule. Estimated quantities (activity and volume) of liquid radioactive wastes from the typical large nuclear plant are based on a limited amount of operating experience since the use of such plants is a relatively recent development.

Summary and conclusions. Following the Conference on pollution of Lake Michigan and its tributary basin in early 1968, a Committee was formed by the Conferees to consider the disposal of thermal and radioactive wastes from nuclear power plants to be located on Lake Michigan.

One existing and six proposed nuclear power plants with an electrical production capacity of 7,100,000 kilowatts will be in operation on the shores of Lake Michigan within the next decade, with all but one scheduled for completion by 1973. This proposed capacity probably will be only a little less than the estimated 7,700,000 kwe existing fossil fuel power plant capacity.

Since the turn of the century, thermal power plant production throughout the Nation has approximately doubled every 10 years. It is anticipated that the availability of a large source of cooling water in Lake Michigan and the expanding industries on its shores will support an even greater increase in power production in this area than the national average. Most of the increased capacity probably will be in nuclear power plants.

The AEC predicts that there will be need for an additional 6,000,000 kilowatts of electrical capacity on Lake Michigan by 1980.

Existing fossil fuel plants operating at full capacity discharge an estimated 300,000 billion BTU's per year in cooling water to the lake. Nuclear reactor power plants discharge 40 to 50 percent more waste heat per unit of electrical production to the cooling water than do fossil fuel plants, and it is estimated that the seven nuclear plants when in full operation will discharge 388,000 billion BTU's per year to the lake. If all plants, both existing and proposed, operated at full capacity for a year, and if there were no reduction of the added heat through evaporative cooling and other means, and assuming complete mixing of the entire lake, the temperature of the lake would be raised a little more than 0.06°F annually.

The foregoing calculation assumes no reduction in the heat of the cooling water added to the lake, but actually there will be much reduction through evaporation, radiation and other means. There will, however, be a residual of the added heat that will be cumulative until an equilibrium is reached at a somewhat higher temperature than that due to natural causes. It is estimated that with an average annual temperature of 50°F. for the lake the added heat would raise the average annual temperature at equilibrium by 0.05°F. to 50.05°F. With increasing power production and no off-lake cooling, it is estimated the average annual temperature would be increased by 0.4°F. in the year 2000, and by 2.0°F. in 2023. This increase would nullify a 2.0°F. decrease in average annual temperature of the lake that has occurred, apparently from natural causes, in the past 100 years.

These conservative calculations indicate that there is minimum need for immediate concern over the effect of temperature on the lake as a whole. The probable long-range effect deserves consideration.

Possible local effects of increased temperature on aquatic life, including fish, are cause for more immediate concern than the effect on the lake as a whole. Fish and the aquatic organisms that serve as their food are particularly sensitive to variations in seasonal temperature during reproductive and juvenile stages. For example, abnormally high temperatures during the spawning and hatching season may completely upset the normal reproductive cycle of fish and thus limit or prevent their production. It also is possible that increased temperature of lake water locally may stimulate undesirable growths of plankton and filamentous algae, and lead to production of nuisances.

Of the four States bordering the lake, Illinois and Indiana have temperature standards, approved by the Secretary of the Interior,that require that the maximum temperature of Lake Michigan water not exceed 85°F. after reasonable allowance for mixing. The Wisconsin standard also approved by the Secretary allows up to 89°F. after mixing, at the shoreline and in harbor waters. Some, but not all, of these standards also include various provisions limiting rates of temperature increase and increases over natural temperature. The Michigan standard, which has not been approved by the Secretary, establishes no numerical limits, but is a general statement designed to abate or prevent injury of any kind due to temperature to any type of water use or value.

All four States grant approval for the nuclear power plants with the understanding that requirements may be revised if experience proves the need for revision.

Most of the plants propose to draw cooling water from some distance out in the lake where the temperature only infrequently will be above 65°F. Thus the temperature of the cooling water can be increased a reasonable amount without exceeding the standards for the lake water. Most of the plants propose to discharge the cooling water through channels ending at the shoreline; though one (Zion, in Illinois) plans to discharge through a dispersion device about 700 feet from shore. Discharge velocity at the shoreline of two to four feet per second will tend to float the warm water on the lake surface with a minimum of mixing. This will allow cooling from evaporation and radiation, and minimum addition of heat to the lake water, but will permit maximum temperature of the floating heated water mass before cooling. Since such discharges generally tend to travel up or down the shoreline rather than out into the lake, the greatest damage to aquatic life along the shore could result from this method.

Large quantities of cooling water are required by nuclear power plants. The Zion plant, for example, will use an annual average of 2,940 cfs, with a maximum of 3,400 cfs in summer. If all plants anticipated by 1980 used cooling water at the same rate as Zion, the cooling water use by then could average 17,500 cfs, with a maximum of 20,000 cfs in summer. If evaporative cooling towers had to be used for all of this water and there were a two percent loss of water by evaporation, the total water evaporated would be 400 cfs in summer. If power production continued to double and evaporative cooling towers were used for all cooling water, the rate of evaporation by the year 2000 could be 1,600 cfs.

Dry cooling towers are feasible but less efficient and more costly than evaporative cooling towers.

The alternatives for disposal of cooling water, and their protential advantages and disadvantages appear to be:

1. Use of evaporative cooling towers and other off-lake cooling devices. Least thermal effect on lake water quality and uses. Maximum diversion of lake water by evaporation.

2. High velocity dispersion through submerged devices well out into lake. Minimal

immediate thermal effect on water quality and uses; but maximum addition of heat and increase in lake temperature on long-term basis. Minimum evaporation of heated water.

3. Low velocity discharge to surface at shoreline to float water on surface. Maximum potential for damage to aquatic life along the shoreline. More diversion of lake water by evaporation than high velocity dispersion and mixing; but less addition of heat to lake on long-term basis.

Unfortunately, the present state of the art does not allow quantitative estimates of the various potential effects of heated waste discharges on a body of water as complex as Lake Michigan.

Much can be learned of effects of heat on lake water by investigations of aquatic life in the vicinity of existing fossil fuel power plants.

Radionuclides are produced in reactors by both fission of nuclear material and by neutron activation of reactor materials, of minerals in the water used as a coolant to produce steam, and of the hydrogen of the water itself. The nuclides thus produced find their way into the waste stream through leaks in various types of equipment and from the laboratory and laundry.

Treatment by detention and decay, sedimentation, filtration, evaporation and demineralization reduces all radionuclides except tritium to very low levels. Tritium is radioactive hydrogen that is incorporated in the water, and is not removed by any of the treatment processes. Fortunately, tritium is one of the least hazardous of all radionuclides, and has one of the highest maximum allowable limits in drinking water (3×10^{-3} μc/ml). Estimated discharge of all radionuclides, except tritium, from all proposed nuclear power plants totals less than one curie per year. Experience at four of six relatively small plants already in operation, however, has shown discharge of radionuclides ranging from 1.3 to 11.1 curies per year. Tritium discharged by the six plants ranged from five to 1,300 curies per year. The radioactive wastes of the six plants, after treatment, were in volumes ranging from 208 to 4,820 gallons per day.

The treated radioactive wastes will be diluted in the large volumes of cooling water for final disposal to the lake. Discharge will be by batches after each batch has been sampled and analyzed. Dilution in the cooling water is estimated to bring the radionuclide concentrations, including tritium, down to 10 to 20 percent of the permissible limits specified in the Atomic Energy Commission's 10CFR20 regulations. The States standards generally require that radionuclide concentrations comply with the Public Health Service Drinking Water Standards. Compliance with the AEC 10CFR20 regulations will ensure compliance with the PHS Drinking Water Standards.

A basis for evaluation of the possible effect on the lake as a whole is that 490,000 curies of radioactivity would have to be present to give a concentration--

MR. STEIN: Do you mean four hundred ninety or forty-nine thousand?

MR. KITTRELL: Four hundred ninety thousand.

MR. POOLE: The report says 49,000, Kit. I looked it up last night.

MR. KITTRELL: The report says 490,000.

MR. POOLE: It can't be 490,000 10^{-8} and

490,000 10^{-7}.

MR. KITTRELL: That would be 49,000, then, I guess. I have this written report right here, if you want me to take a minute to look it up. You say how much?

MR. POOLE: Last night I looked in the report and it is 49,000 of 10 to the minus 8.

MR. STEIN: That is what it says here, 49,000 of 10^{-8} and 490,000 of 10 to the $^{-7}$.

You know, you guys just--

MR. KITTRELL: It should be 49,000, then.

MR. STEIN: 49,000 of 10^{-8}. You still insist on using these factors that require advanced mathematics to understand. I can't see what that adds to a whole number, but they persist in doing that. And here we come up with a difference of a magnitude of ten in two lines when you are dealing with the same figure when one is to the minus eight, ten to the minus eight, and the other is ten to the minus seven.

Kit, I know this isn't you, but I can say for a fellow who is working for the past years with the Committee on Radiation Protection from the beginning, I cease to be amused by this game that they play with this minus eight, minus seven and minus three to confuse everyone with the numbers. Why can't you come out with a straight number on this so people can follow it?

By the way, this is not directed at you.

MR. KITTRELL: Well, I agree with you, Murray. It took me quite a long time to get accustomed to it.

MR. STEIN: I know.

MR. KITTRELL: Ten to the minus so on and so forth. But on the other hand, I think .0000008 might be almost as confusing.

But anyhow, let me start this sentence over again.

A basis for evaluation of the possible effect on the lake as a whole is that 49,000 curies of radioactivity would have to be present to give a concentration of 10^{-8} uc/ml (10 percent of permissible level), or 490,000 curies for a concentration of 10^{-7} µc/ml. Nearly 1.5 billion curies of tritium would be required to equal the permissible concentration for this radionuclide in the lake. There is no cause for concern for the effects of radioactive wastes on the lake as a whole.

There is a possibility of concentration of radioactivity locally in the aquatic life that serves as the food chain for fish, with a potential hazard to those who eat fish from the lake. Experience with wastes from smaller nuclear power plants discharging to streams in Illinois and Wisconsin and to the lake in Michigan has not revealed such a problem, but it is one that must be evaluated when the larger plants go into operation on the lake.

The policy of AEC and the States that radioactive wastes in the environment must be kept to the lowest practical level requires that radioactive discharges from the nuclear power plants be held to the minimum feasible quantities.

Review of available literature, attendance at national symposia on thermal pollution, and discussions with various consultants in the field have revealed many gaps in knowledge of the effects of thermal wastes on water quality and uses and of preferable means of disposal. There is an urgent need for investigation, especially biological, of the effects on Lake Michigan of heated wastes discharged from existing fossil fuel power plants.

There also is a need for acquisition of data on present water quality and aquatic life in the vicinities of the proposed nuclear power plants to provide a basis for evaluation of effects of the wastes after the plants go into operation. Various power companies and consultants and Federal and State agencies presently are making more or less independent investigations. All of these investigations should be coordinated to the maximum extent possible.

RECOMMENDATIONS

It is recommended that:

1. All power plants, both nuclear and fossil fuel, meet the waste disposal requirements and water quality standards of the States in which they are situated.

2. Design personnel for all future power plants consider or evaluate the possible subsequent addition of off-lake cooling devices, extended cooling water effluent lines with submerged, high velocity discharges, and other methods of controlling effects of thermal wastes on the lake so that such devices can be

added if found to be necessary.

3. Radioactive liquid wastes discharges to the lake be kept to the minimum feasible.

4. Individual States ensure that adequate base line data on water quality and aquatic life be obtained at all proposed power plant sites, and that adequate post-operational monitoring be provided, and results be made available to all parties concerned.

5. Coordinated study of the thermal effects on water quality and aquatic life of one or more fossil fuel plants now discharging cooling water to Lake Michigan, and of various methods of cooling water dispersion be undertaken by FWPCA.

6. FWPCA coordinate a comprehensive study of the effects on water quality and aquatic life of thermal wastes from a large nuclear power plant on Lake Michigan, with attention to various methods of cooling water dispersion.

7. FWPCA coordinate a study of the effects on water quality and uses of radioactive wastes from a large nuclear power plant on Lake Michigan, with especial attention to the concentration of radionuclides in aquatic

life.

8. The Atomic Energy Commission be requested to coordinate the development of a plan for the State agencies, the FWPCA, the U. S. Public Health Service, and other appropriate agencies, for emergency methods to deal with accidental radioactive releases (gaseous as well as liquid) on Lake Michigan, including an inventory of appropriate laboratory and evaluation resources.

(The following is the document submitted by Mr. Kittrell:)

REPORT
of the
COMMITTEE ON NUCLEAR POWER PLANT WASTE DISPOSAL
to the
CONFEREES OF THE LAKE MICHIGAN ENFORCEMENT CONFERENCE
NOVEMBER 1968

INTRODUCTION

A Conference on pollution of Lake Michigan and its tributary basin (Wisconsin-Illinois-Indiana-Michigan), requested by Governor Otto Kerner of Illinois and called by Secretary of the Interior, Stuart L. Udall, was held in Chicago, Illinois, on January 31, February 1-2, February 5-7, March 7-8, and March 12, 1968.

Among problems discussed by the Conferees was the disposal of waste radioactive material and heat from nuclear power plants scheduled to be located on the shores of Lake Michigan within the next five years. They concluded that insufficient information was available to them at that time to judge the potential effects of these wastes on water quality of Lake Michigan.

The Conferees' tenth recommendation, among a total of twenty-six, was:

"The States and the Department of the Interior will appoint members of a special committee on nuclear discharges and the thermal pollution aspects of power plants and reactors. The committee will meet with representatives of the Atomic Energy Commission and other interested parties to develop guidelines for pollution control from nuclear power plants. The committee is to pay special attention to thermal discharges which affect the aquatic life environment of the lake. Representatives of the committee will be available to appear before any

Federal or State agency considering approval of a permit for such power plants and reactors."

Members of the committee appointed by the Conferees are:

F. W. Kittrell, Chairman, Public Health Engineer, Federal Water Pollution Control Administration;

C. T. Blomgren, Sanitary Engineer, Illinois State Sanitary Water Board;

L. E. Stratton, Sanitary Engineer, Illinois State Sanitary Water Board;

H. C. Briggs, Sanitary Engineer, Indiana State Board of Health;

J. R. McKersie, Sanitary Engineer, Wisconsin Department of Natural Resources;

J. G. Robinson, Aquatic Biologist, Michigan Water Resources Commission.

Two members of the Committee, Messrs. Briggs and Stratton, have specialized in radiological health. A third, Mr. Robinson, has specialized in aquatic biology. The other three members have had general experience in sanitary engineering and water resources.

F. W. Kittrell

Clifford Risley, Jr., Chemist, FWPCA, served as non-voting Secretary of the Committee, with W. L. Abbott, Chemist, as his alternate.

The Committee first met, for organizational purposes, on May 27, 1968. It has met in seven two-day and one one-day work sessions since that time.

Valuable contributions have been made by the following agencies, which provided speakers on nuclear power plants and on effects and control of their wastes:

Atomic Energy Commission, Chicago Operations Office.

Commonwealth Edison Company, Chicago Office.

Federal Water Pollution Control Administration, Division of Technical Services.

U. S. Public Health Service, Nuclear Facilities Section.

The Atomic Energy Commission and Public Health Service speakers dealt primarily with radioactive wastes. The Commonwealth Edison speakers presented the results of a single field study of thermal wastes from the company's Waukegan fossil fuel plant that included temperature and biological effects on the lake, and described plans for disposal of wastes from the company's Zion nuclear power plant. FWPCA representatives provided information on heat losses from power plants, effects of thermal discharges on aquatic life, and consultation on radiological wastes.

Committee members also have discussed the problems involved with knowledgeable individuals, attended national meetings on thermal pollution, and reviewed much literature on the subject.

Although isolated cases of thermal pollution have been recognized for many years, only recently has concern over the problem become widespread. This concern has developed because of increase in thermal power production, which is doubling approximately every ten years, using both nuclear and fossil fuel, and because of the increasing capacity of individual power plants.

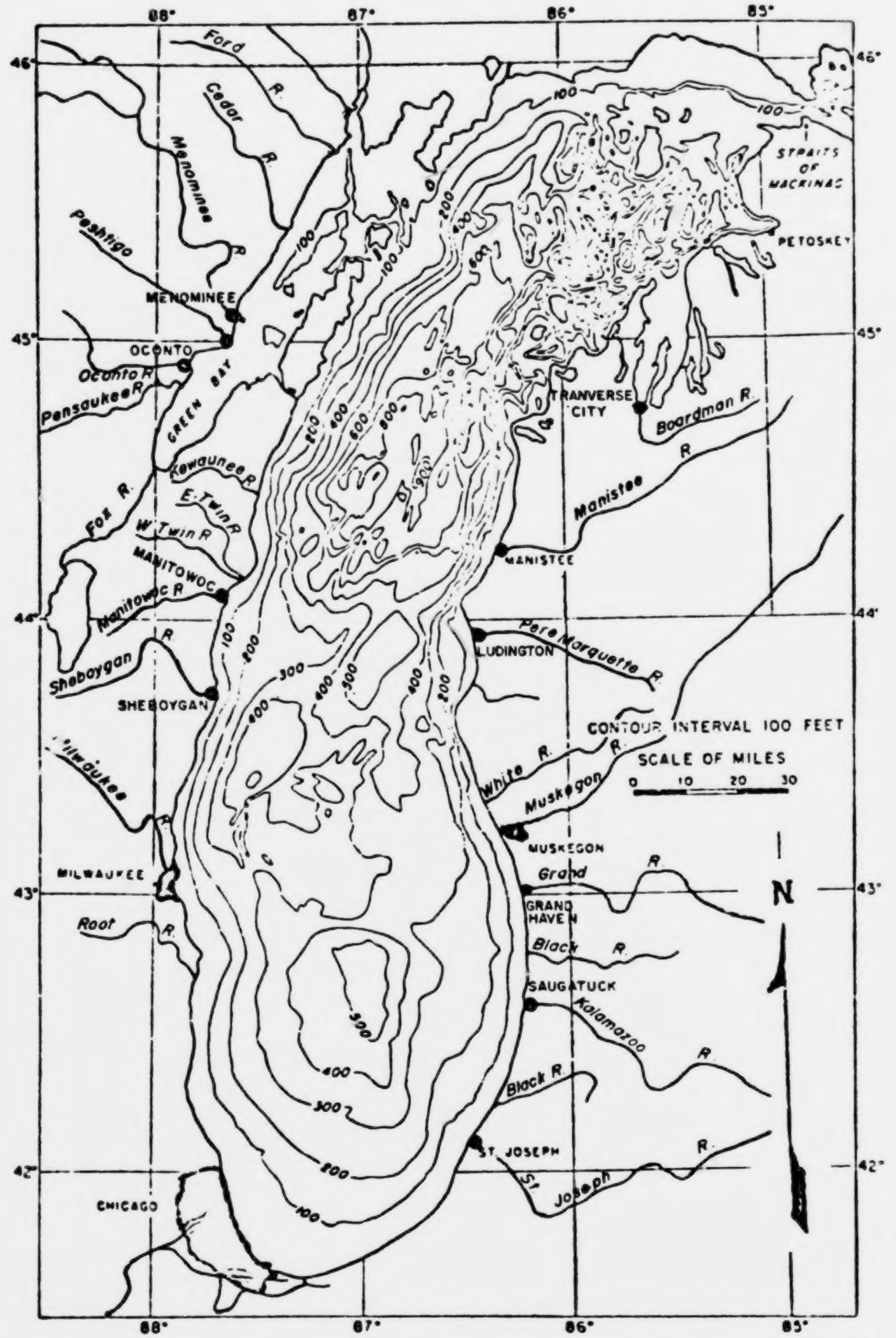
Because of relatively limited attention to thermal pollution in the past, there are few experts in the disposal of waste heat and many gaps in knowledge of behavior of waste heat in receiving waters, of its effects on water quality and uses, and of the most efficient and economical methods of disposal without damage to the aquatic environment. For example, methods of calculating the patterns that will be assumed in lake waters by heated water discharges, and the rates of cooling that may be anticipated in the receiving waters are in the developmental stage. Much additional research will be necessary before it will be possible to predict with assurance what heated water will do when discharged to a lake.

Liquid radioactive wastes, on the other hand, have received a great deal of publicity and attention, and means for the effective treatment and acceptable disposal of them are well known. Of all the radionuclides that are most likely to be constituents of the liquid wastes, only tritium is not directly amenable to removal by accepted methods of treatment such as evaporation or demineralization. This is because tritium is a "heavy" hydrogen atom, and exists therefore as an integral part of the water molecule. Estimated quantities (activity and volume) of liquid radioactive wastes from the typical large nuclear plant are based on a limited amount of operating experience since the use of such plants is a relatively recent development.

LAKE MICHIGAN

The Lake

Lake Michigan (Figure 1) is the sixth largest fresh-water lake on earth, with a surface area of 22,400 square miles, an average depth of 276 feet, and a volume of 1,116 cubic miles, or 1,230,000 billion gallons. The lake surface is nearly one-third of the total drainage area. The lake is divided into two basins by a submerged ridge, averaging about 230 feet below the surface, that runs roughly from Grand Haven, Michigan, to Milwaukee, Wisconsin. The water surface elevation averages about 580 feet above sea level, and the maximum depth of 923 feet in the northern basin extends 343 feet below sea level. The coastline, with the exception of Green Bay and Little Traverse and Grand Traverse bays, is quite regular. Much of the shoreline is sandy and provides excellent beaches for bathing, but constitutes poor underwater surfaces for attachment and growth of aquatic organisms.



88°
87°
86°
85°
46°
45°
44°
43°
42°
Ford R.
Cedar R.
Menominee R.
Peshtigo
MENOMINEE
OCONTO
Oconto R.
Pensaukee R.
GREEN BAY
Fox R.
Kewaunee R.
E. Twin R.
W. Twin R.
MANITOWOC
Manitowoc R.
Sheboygan R.
SHEBOYGAN
Milwaukee
MILWAUKEE
Root R.
CHICAGO
STRAITS OF MACKINAC
PETOSKEY
TRANVERSE CITY
Boardman R.
Manistee R.
MANISTEE
LUDINGTON
Pere Marquette R.
White R.
Muskegon R.
MUSKEGON
Grand R.
GRAND HAVEN
Black R.
SAUGATUCK
Kalamazoo R.
Black R.
ST. JOSEPH
St. Joseph R.
CONTOUR INTERVAL 100 FEET
SCALE OF MILES
0
10
20
30
N
100
200
300
400
500
600
800
900

LAKE MICHIGAN

FIGURE 1

The greatest portion of the lake is in the State of Michigan, with 12,350 square miles, or 55.1 percent of the total surface area. Wisconsin has 7,550 square miles, or 33.7 percent, Illinois 2,280 square miles,or 10.2 percent, and Indiana only 224 square miles, or 1.0 percent.

The lake discharges at its northern and southern ends. Its natural flow, estimated to be in the approximate range of 40,000 to 55,000 cubic feet per second (cfs), is through the straits of Mackinac into Lake Huron, and a diverted flow of 3,200 cfs is into the Chicago Sanitary and Ship Canal. The combined annual outflow is equivalent to about one percent of the lake volume.

Currents

The lake currents are quite variable.(1) Figures 2A and 2B show the four principal circulation patterns in Lake Michigan. In the main body of the

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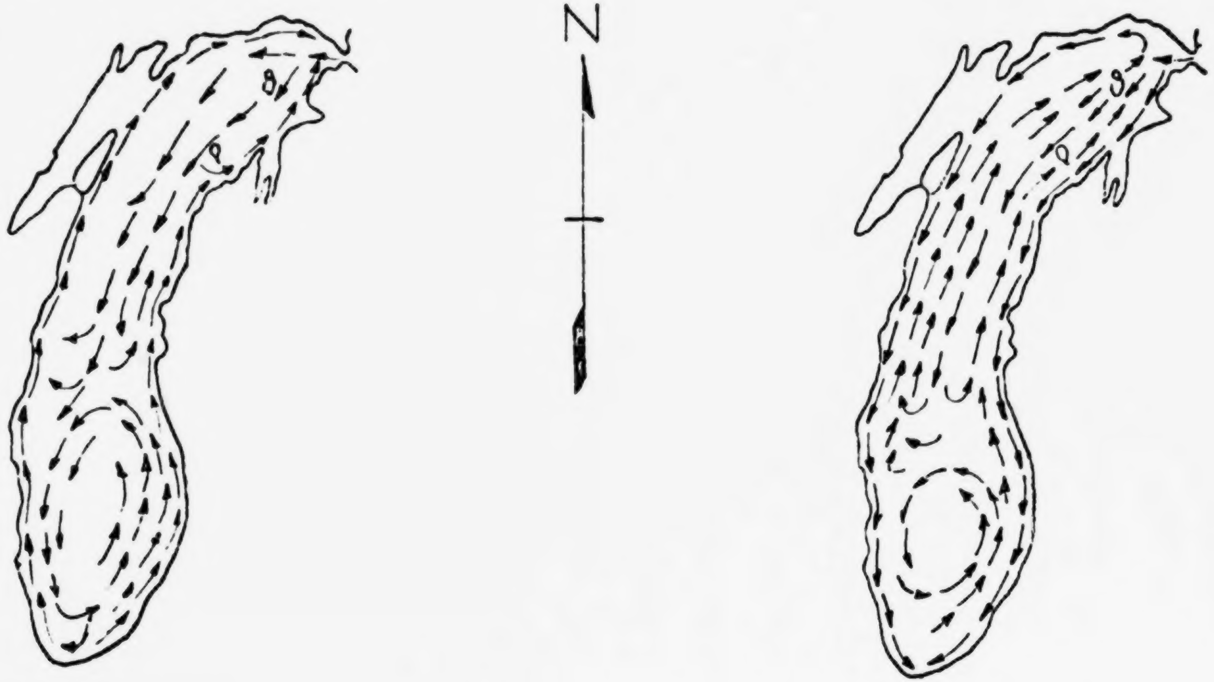
(1) "Lake Michigan Currents." Great Lakes Region, Federal Water Pollution Control Administration, Chicago, Illinois (Nov. 1967).

F. W. Kittrell

northern basin the currents revolve in a clockwise direction 25 percent of the time and in a counterclockwise direction 25 percent of the time. The other half of the time they flow toward the south in the middle of the basin, split near the lower end, and return in a northerly direction on each side of the central southerly current. In the sothern basin, the main currents revolve in a clockwise direction 25 percent of the time, and in the opposite direction 75 percent of the time. The principal importance of these currents in the consideration of this Committee is that they cause rather complete mixing of all waters of the lake over a period of time.

Of more significance in this Committee's considerations are the currents nearer shore (Figure 3) which flow in opposite direction to the main currents between 10 and 90 percent of the time, depending on the season of the year, and the point on the lake involved, whether on the east or west shore, and whether in the northern or southern basin. Thirty-five percent of the time these currents flow in a southerly direction and sixty-five percent of the time in a northerly direction, in both basins.



SUMMER CIRCULATION
S-SW WINDS

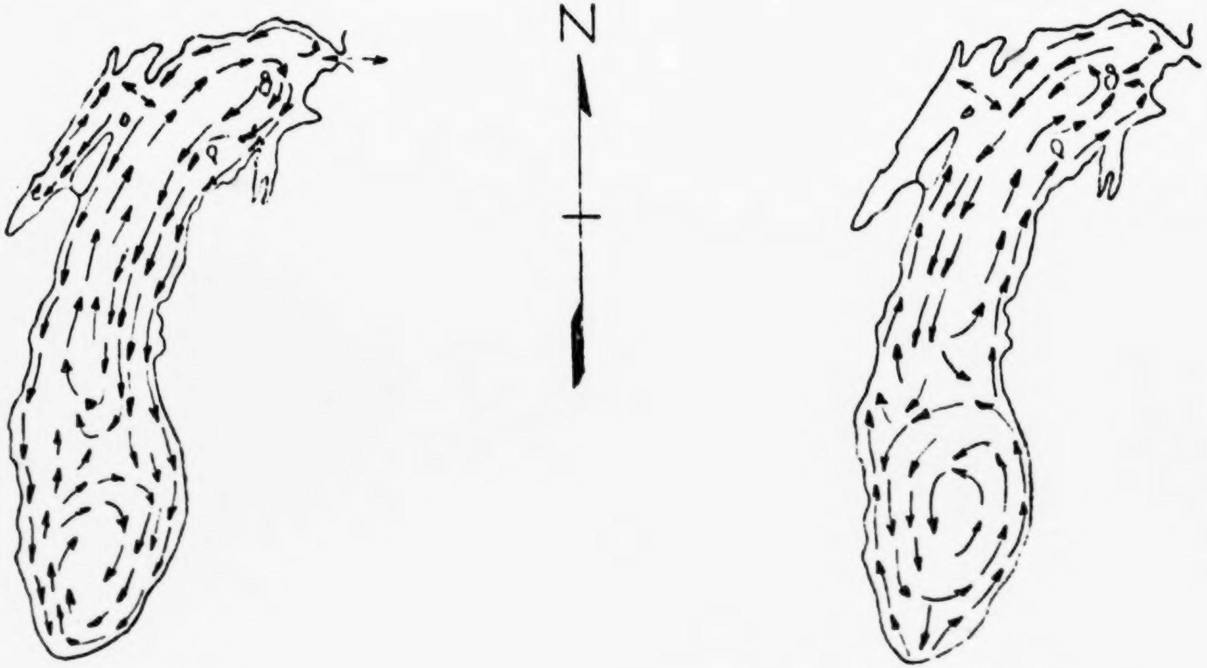
SUMMER CIRCULATION
N NE WINDS

GENERAL CICULATION PATTERNS

PREVALENT CURRENTS AT SURFACE

LAKE MICHIGAN

Figure 2A



WINTER CIRCULATION
N-NW WINDS

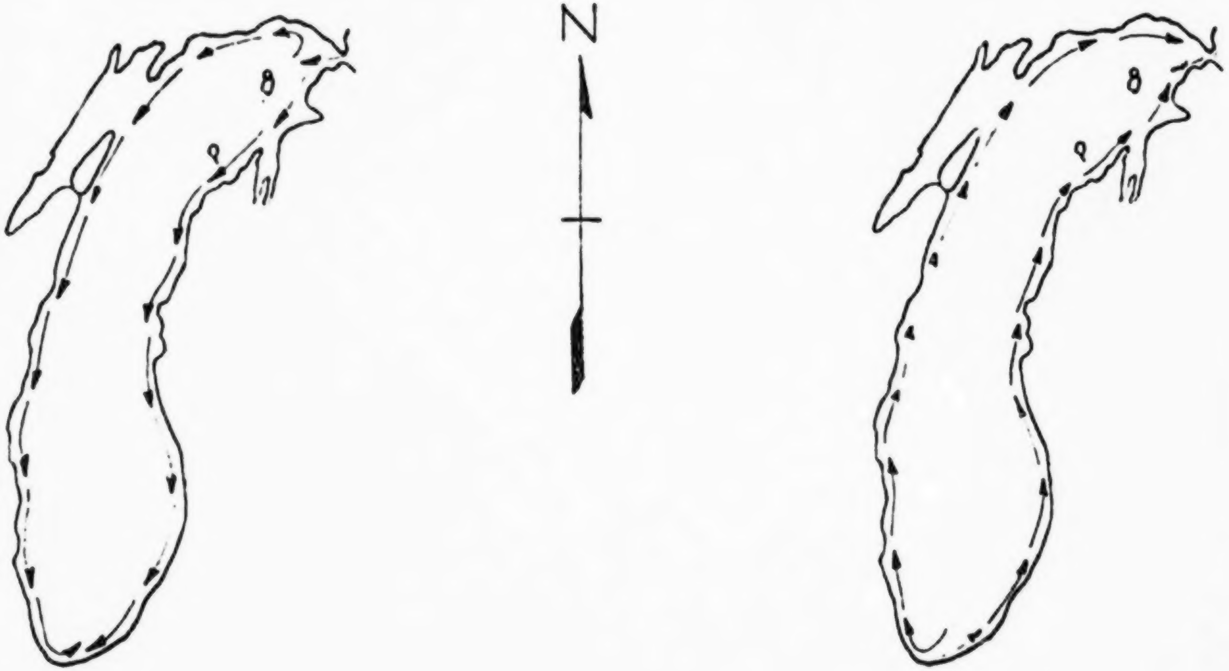
WINTER CIRCULATION
S-SW WINDS

GENERAL CIRCULATION PATTERNS

PREVALENT CURRENTS AT SURFACE

LAKE MICHIGAN

Figure 2B



SUMMER CIRCULATION
N NE WINDS

SUMMER CIRCULATION
S-SW WINDS

INSHORE CURRENTS

LAKE MICHIGAN

Figure 3

Of still greater importance in this Committee's considerations are the currents quite near shore, in water less than 30 feet deep, especially in connection with those power plants that discharge at the shoreline rather than at some distance out into the lake. Such shore currents are not necessarily subject to the main movements of water in the lake, but are greatly influenced by wind direction, the local shape of the shoreline and by natural and man-made obstructions, such as tributaries, coves, jetties from harbors or tributaries, marina basins and breakwaters. The true pattern of such currents can be determined only by observations in the areas involved.

Stratification

A phenomenon that has not generally been recognized was reported in "Lake Michigan Currents."(2) Water along the shore has been found to have a different temperature from that farther offshore. For example, in summer shore water out to a depth of 23 to 33 feet in Lake Michigan may be 9°F. or more warmer than that offshore. The change in temperature is quite abrupt. The vertical interface where the waters with different temperatures meet has been called a "thermal bar" and may be likened to a fragile partition separating shore waters from the main body of the lake. It is stated that such a bar is intermittent and may occur at any time during the year. Although fragile, the thermal bar offers some resistance to mixing, and may in part account for reports that wastes discharged at the shores of large lakes frequently tend to travel along shore in either direction from the point of discharge, rather than out into the main body of the lake. This will be important in shoreline disposal of heated wastes in those areas where substantial populations of aquatic life exist. Potential damage to such life is greater in the shallow waters in the vicinity of the shore than it would be farther out into the lake.

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(2) ibid.

A better known feature of Lake Michigan is the typical stratification (horizontal) that is found in most deep lakes. The lake may stratify in both summer and winter, although winter stratification was not found in the shallower and somewhat warmer southern basin during the 1961-1963 current study. In summer, the surface water warms up more rapidly than the deeper water and continues to become less dense until it becomes separated from the deeper water by a transitional, horizontal stratum (thermocline) between the warm surface water and the colder and more dense water underneath. The temperature of the water below the thermocline remains near that of the previous winter, with only minimal warming as summer advances. This separation of the two strata of water starts in lake May and persists until November or occasionally into December in the southern basin. In the northern basin, summer stratification may not begin until late June or early July and likewise may persist into December. The warm surface stratum is only a few yards deep when first formed, but it deepens throughout the summer, and may be as much as 200 feet deep by late fall. This means that water intakes designed to withdraw cold water from the depths of the lake would have to extend into the lake as much as 30 miles at the southern end, but as little as two miles in limited reaches along the east side to ensure withdrawal of the cold water at all times.

NUCLEAR POWER PLANTS

One small nuclear power plant is already situated on Lake Michigan. Five others are under construction, or have had plans approved or plans submitted for approval. A seventh is proposed but no plans have been submitted. Locations of the seven nuclear plants and of existing major fossil fuel plants are shown on Figure 4. The figure includes electrical capacities of the plants. The 7,100,000 electrical kilowatts (kwe) capacity of the 7 nuclear power plants will be 52 percent more than the 4,690,000 kwe of the 6 major fossil fuel plants. However, the total present capacity of all fossil fuel plants on the lake, including those at industrial plants is estimated to exceed that of the existing and proposed nuclear plants.

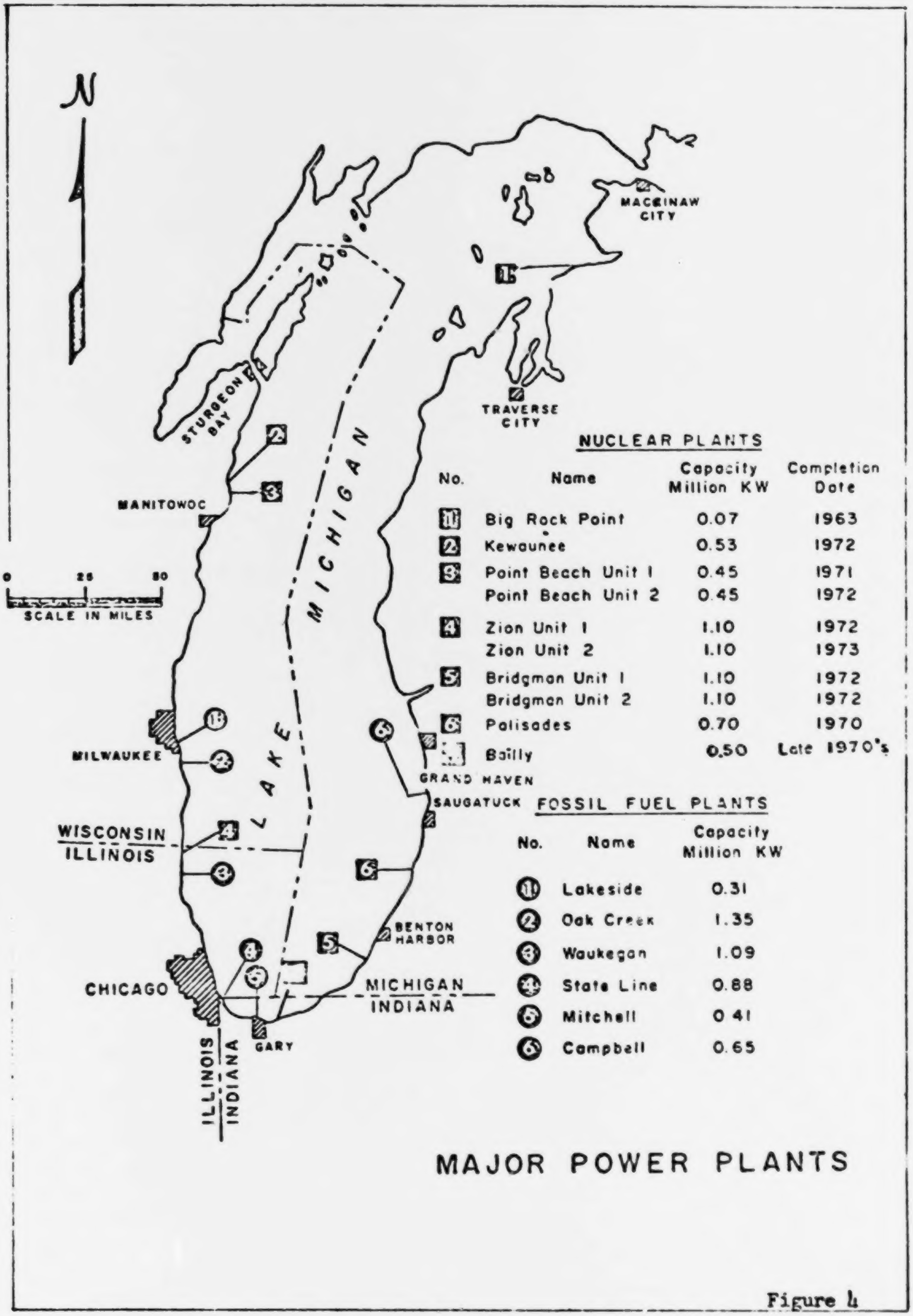
General Design

The Big Rock Point plant has been in operation since 1963. It is a boiling water reactor (BWR) plant, and it, along with the Bailey plant, are the only ones of this type among the seven. The Big Rock Point plant is the smallest, with only 70,000 kwe capacity, or less than one percent of the total of 7,100,000 kwe for the 7 nuclear plants. The other five plants will be pressurized water reactors (PWR).

The Point Beach, Kewaunee, Zion, and Palisades plants already are under construction. Construction of the Bridgeman and Bailey plants has not yet started.

Of the 7 nuclear plants 3, with 1,500,000 kwe capacity, will be located on the shores of the northern basin of Lake Michigan, and 4 with a total of 5,600,000 kwe, will be located on the smaller southern basin. Three plants with a capacity of 2,970,000 kwe will be in Michigan, two with a capacity of 1,430,000 kwe in Wisconsin, one with a capacity of 2,200,000 kwe in Illinois, and one with a capacity of 500,000 kwe in Indiana.

In a BWR plant steam is produced directly in the nuclear reactor from water circulating around and through it (Figure 5). A PWR plant has a closed "loop" of water, known as the "primary coolant" that circulates under high pressure (as much as 2,500 psig) between the reactor and a boiler. The water of the primary loop


N
0
25
50
SCALE IN MILES
MACKINAW CITY
TRAVERSE CITY
STURGEON BAY
MANITOWOC
MILWAUKEE
WISCONSIN
ILLINOIS
CHICAGO
GARY
ILLINOIS
INDIANA
MICHIGAN
INDIANA
BENTON HARBOR
SAUGATUCK
GRAND HAVEN
LAKE MICHIGAN

NUCLEAR PLANTS

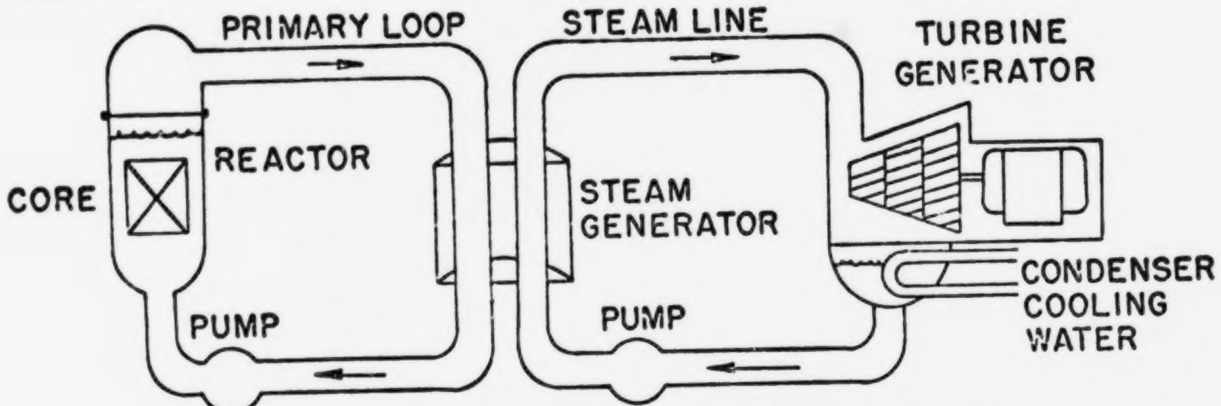
No.	Name	Capacity Million KW	Completion Date
1	Big Rock Point	0.07	1963
2	Kewaunee	0.53	1972
3	Point Beach Unit 1	0.45	1971
	Point Beach Unit 2	0.45	1972
4	Zion Unit 1	1.10	1972
	Zion Unit 2	1.10	1973
5	Bridgman Unit 1	1.10	1972
	Bridgman Unit 2	1.10	1972
6	Palisades	0.70	1970
	Bailly	0.50	Late 1970's

FOSSIL FUEL PLANTS

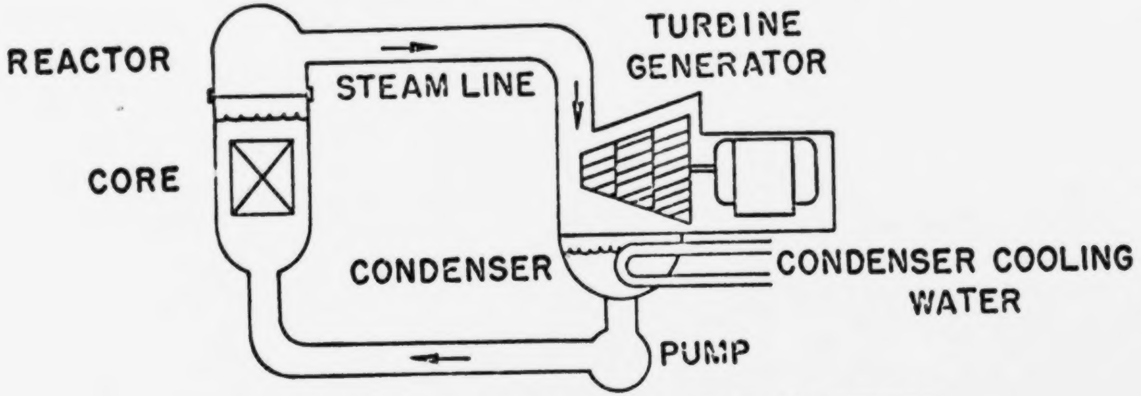
No.	Name	Capacity Million KW
①	Lakeside	0.31
②	Oak Creek	1.35
③	Waukegan	1.09
④	State Line	0.88
⑤	Mitchell	0.41
⑥	Campbell	0.65

MAJOR POWER PLANTS

Figure 4


PRIMARY LOOP
STEAM LINE
TURBINE GENERATOR
REACTOR
CORE
STEAM GENERATOR
CONDENSER COOLING WATER
PUMP
PUMP

PRESSURIZED WATER REACTOR SYSTEM


TURBINE GENERATOR
REACTOR
STEAM LINE
CORE
CONDENSER
CONDENSER COOLING WATER
PUMP

BOILING WATER REACTOR SYSTEM

NUCLEAR FLOW DIAGRAMS

Figure 5

does not boil but yields its heat in the boiler to a secondary water cycle, under lower pressure, where steam is produced.

The nuclear reactor heat source consists of containers of stainless steel or zirconium alloy (cladding) encasing pellets of natural uranium dioxide, which are enriched with uranium-235. The nuclear chain reaction is controlled by rods of neutron-absorbing materials such as cadmium, boron, indium and silver. In the PWR, boron is added to the primary coolant to provide additional control of the reaction.

From the point of production of steam through the generation of electricity, the condensation of the exhaust steam with cooling water, and the return of the condensate to the heat source, the process in nuclear power plants is the same as that in a fossil fuel plant.

Predicted Increase

Production of electric power has approximately doubled in this country every 10 years since the turn of the century, and the same rate of increase is expected to continue at least to the Year 2000.

F. W. Kittrell

It is anticipated that Lake Michigan, with large volumes of cooling water available and with rapid industrial growth along its shores will experience a higher rate of increase than the national average.

The AEC Reactor Development Division has estimated probable increases in nuclear power production on Lake Michigan by 1980, but not beyond. These estimates, based on anticipated increased power demands for companies serving the area, are:

Commonwealth Edison	3,000,000 kwe
Wisconsin Power and Light	500,000 kwe
Wisconsin Public Service	500,000 kwe
Indiana and Michigan Electric	2,000,000 kwe
TOTAL	6,000,000 kwe

The last of the nuclear power plants (Bailey) presently planned for lcation on Lake Michigan is scheduled for completion in the late 1970's. The total capacity of the seven plants is 7,100,000 kwe. The total capacity of the predicted additional plants is 6,000,000 kwe. This does not include capacities of any fossil fuel plants that may be built.

WASTES

General

The principal liquid wastes discharged from nuclear power plants to receiving waters contain radioactive materials and heat. Both of these constituents are discharged in the large quantities of cooling water used to condense the exhaust steam for return to the heat source.

Other waste materials, which were not specified for consideration by the Committee, may include: bacteria and other constituents of sewage from employees; residual chlorine, algicides or fungicides used to control slimes in cooling water equipment; phosphates, chromates or other corrosion inhibitors; boron from the primary coolant of PWR's; minerals in boiler water blowdown; and chemicals used in regenerating de-ionizing resins.

Radioactive Wastes

The nuclear power units proposed for Lake Michigan are larger than any currently in operation. There are no operating experiences to indicate the quantities of radioactive wastes from plants of these capacities. The practice has been to estimate these wastes on the basis of extrapolated data from operating experiences of smaller installations, on assumed values of fission product leakage from the fuel elements into the primary coolant, and on efficiencies of various waste treatment processes.

Origin

The radioactive materials originate in the reactor and reach the waste stream by several routes. Small quantities of radionuclides produced by fission in the reactor enter the primary coolant. Other radionuclides are formed by neutron bombardment of the water and the metals of the reactor equipment. The latter may either go into solution in the coolant or may become suspended in it as soluble corrosion products. Radioactive materials may escape from the high pressure primary coolant system through leaks in valves, joints, pumps, and other imperfections of the equipment. In order to prevent excessive build-up of radioactive materials in the primary coolant system, it is necessary to withdraw a portion of the coolant from time and treat it for removal of radioactivity.

Other sources of radioactive wastes are the nuclear fuel storage pool, the laboratory and the laundry.

Volumes

Final volumes of the treated radioactive wastes from the large plants may be typified by that estimated for one of them (Zion - 2,200,000 kwe)(Table 1). The total estimated volume os 2,920,000 gallons per year or 8,000 gallons per day (gpd). The waste will be in two categories, one being 6,000 gpd with mixed radionuclides, and the other 2,000 gpd containing tritium.

Actual data for four smaller BWR plants (24 to 200 kwe) show that final radioactive waste volumes ranged from 208 to 4,820 gpd. Waste volumes from two small PWR plants (163 to 185 kwe) were 24,100 and 2,330 gpd.(3)

Radionuclides

Table 1 is an example of estimated

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(3) Blomeke, J. O., and Harrington, F. E., "Waste Management at Nuclear Power Stations." Nuclear Safety, Vol. 9, No. 3 (May-June, 1968).

TABLE 1

EXAMPLE OF ESTIMATED RADIOACTIVE WASTE DISCHARGE FROM A NUCLEAR POWER PLANT
(Zion - 2,200,000 kwe)

Radionuclide*	Concentration -μc/cc
Co 60	4.3×10^{-8}
Co 58	3.6×10^{-7}
Cs 137	5.6×10^{-6}
I 135	3.1×10^{-6}
Cs 134	1.0×10^{-6}
I 133	6.3×10^{-6}
I 131	8.1×10^{-6}
Mo 99	1.5×10^{-5}
Y 91	2.6×10^{-9}
H 3	2.5
Mixed radionuclide waste discharge	6,000 gpd**
Tritium waste discharge	2,000 gpd
Average annual cooling water discharge	1,320,000 gpm
Total mixed radioactivity (exclusive of tritium)	0.25 curies per year
Total tritium radioactivity	6,075 curies per year
Estimated maximum radioactivity of cooling water (exclusive of tritium)	10^{-8} μc/cc

*Includes more than 99 percent of gross radioactivity.

**May all be released during one-hour period as batch discharge.

radionuclide release after treatment from the proposed 2,200,000 kwe PWR plant at Zion. The 0.25 curies of total activity per year is quite low. Experience at the four smaller BWR plants already in operation in the 24 to 200 kwe range, has shown that several actual discharges have been considerably greater than this, with a range of 0.01 to 5.8 curies per year. The two PWR plants discharged total activity of 0.01 and 11.1 curies per year.(4)

Tritium is not included in any of the above values since it generally is considered separately. The Zion plant is expected to discharge 6,075 curies per year. The four small BWR plants discharged from 5 to 20 curies of tritium per year and the two PWR plants 500 and 1,300 curies per year.(5) Tritium is one of the least hazardous of the radionuclides and has a very liberal maximum permissible concentration (MPC) of 3×10^{-3} uc/ml. Even the 1,300 curies per year discharge resulted in only about one-sixth hundredth of the tritium MPC in the plant cooling water. Tritium, which is radioactive hydrogen, is incorporated in the water molecule and is not removed by treatment processes.

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(4) ibid.

(5) ibid.

Proposed Disposal

All liquid radioactive wastes will be collected for treatment before discharge to the lake. Treatment processes may include detention for radioactive decay, settling of suspended solids, filtration, demineralization of soluble radionuclides, and evaporation. Solids removed from the liquid wastes and ion exchange resins will be disposed of off-site under regulation by AEC. The residual treated liquid wastes will be held in tanks for analysis before batch discharge to the lake in the cooling water. All treatment facilities are designed to meet liquid waste disposal requirements of both AEC and the States in which the individual plants will be situated. Although designed specifically to meet AEC regulation, Title 10 Code of Federal Regulation part 20 (10CFR20), it is anticipated that during normal operation, the radioactivity of the cooling water, with the exception of that due to tritium, will be about 10 to 20 percent of the annual average limit of $10^{-7} \mu c/ml$ for mixed unidentified radionuclides established by that regulation.

Waste Heat

Cooling systems must be designed to deliver sufficient cooling water to condense the exhaust steam efficiently, and at the same time meet temperature standards for the lake.

Origin

Electric steam plants are inefficient in their conversion of thermal energy into electrical energy. Modern fossil fuel plants waste about 60 percent of the thermal energy produced, and convert only about 40 percent into electrical energy. Nuclear plants are even more inefficient, with only about one third of the thermal energy being converted to electrical energy. The lost heat from both types of plants is wastes to the atmosphere from the stack gases, the turbines, the generator and the pumps, and to cooling water in the condensation of exhaust steam. It is the heat in the cooling water that is of concern to this Committee.

The poorer efficiency of nuclear power plants is reflected in both the greater thermal energy necessary to produce a unit of electric power and the greater heat loss to the cooling water. Nuclear plants waste 40 to 50 percent more heat to the cooling water than do fossil fuel plants.

Volume

The volume of cooling water for a unit of electrical production varies with the designed temperature increase of the cooling water. In general, the average reported discharge for large nuclear plants is about 1,300 million gallons per day (2,000 cubic feet per second) for a 1,000,000 kwe plant. The Zion plant is expected to discharge 2,230 cfs in winter, and 3,400 cfs in summer, for an annual average of 2,940 cfs. The latter is very nearly equal to the annual average flow of three of the four largest tributaries to Lake Michigan, the Grand, St. Joseph and Menominee rivers and is nearly three-fourths of that of the largest, the Fox River.

Heat

As noted above, the temperature rise of the cooling water depends on the design of the cooling system. The increase may range from as little as 10°F. to as much as 30°F. The Zion plant is designed to take cooling water from the lake at a reported maximum of

65°F. and return it at 84.6°F., a 19.6°F rise, in summer.

A more nearly constant value than increase in temperature is the total waste heat per unit of power production.

Modern efficient fossil fuel plants can produce one kilowatt hour (kwh) of electrical energy, equivalent to 3,413 BTU's, from about 8,500 BTU's of thermal energy. There has been a continuing reduction in the thermal energy required as plants efficiencies have been improved. An average of 9,000 BTU's of thermal energy per kwh of electrical energy is a more nearly representative value for some older plants. A nuclear power plant requires about 10,000 BTU's of thermal energy to produce one kwh of electrical energy. Federal Power Commission information indicates that the waste heat to cooling water in a nuclear plant averages 6,250 BTU's per kwh. The Zion plant estimate is 6,740 BTU's per kwh. A comparable value for fossil fuel plants is 4,450 BTU's per kwh.

The seven nuclear plants, operated at full capacity, would discharge an estimated 1,063 billion BTU's per day to the lake. The range of heat discharges for the individual plants would be from about 10 to 330 billion BTU's per day.

Proposed Disposal

The cooling water from all plants will be discharged to the lake in the vicinity of the power plants. Most discharges will be at the shoreline through open channels. The Zion plant will discharge 700 feet offshore through a dispersion structure. Discharge velocities generally are reported to be about two to four feet per second. No off-lake cooling facilities are proposed, but all disposal systems are designed to meet the requirements of the States in which the individual plants are located. In general, this means that the maximum temperature in the vicinity of the points of discharge will not exceed 85°F., with a few degrees higher temperatures allowed in some cases for mixing within limited specified distances.

General Patterns of Waste Plumes

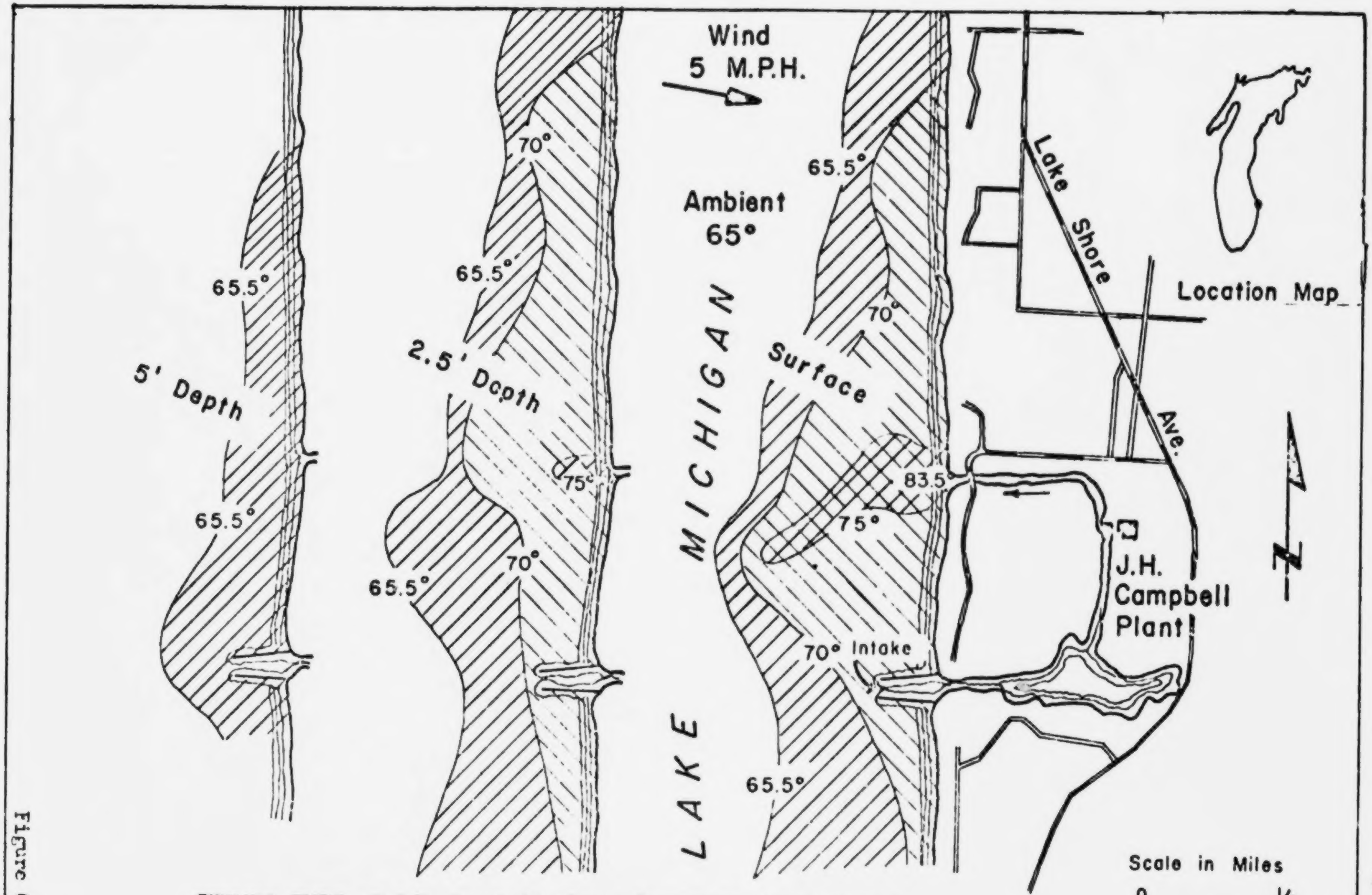
Calculation of the anticipated patterns of heated water that will be produced in the lake by cooling water is not possible at the present stage of development of methods for such calculations. In addition, only a limited number of field observations of actual heated water discharges in Lake Michigan is available. Therefore, only very general comments on probable heated water patterns in the lake are justified.

The warm water pattern in Lake Michigan made by cooling water discharged from the J. H. Campbell Plant (fossil fuel) of the Consumers Power Company at Port Sheldon, Michigan, was observed by the Michigan Water Resources Commission on July 3, 1968. At that time the plant was discharging 579 cfs of water with a temperature of 83.5°F. at the lakeshore through a dug channel. Wind was from the west at five miles per hour(mph). Figure 6 shows details of the pattern of heated water. The plume was about five feet thick and had a temperature of less than one degree above lake water temperature within one-half to one mile offshore. The warm water extended along shore more than one and one-half miles both north and south from the point of discharge.

Observations of the pattern of heated water discharge in the lake were made by FWPCA Chicago Regional Office personnel at the Commonwealth Edison Company's Waukegan Plant (fossil fuel) on May 22, 1968.

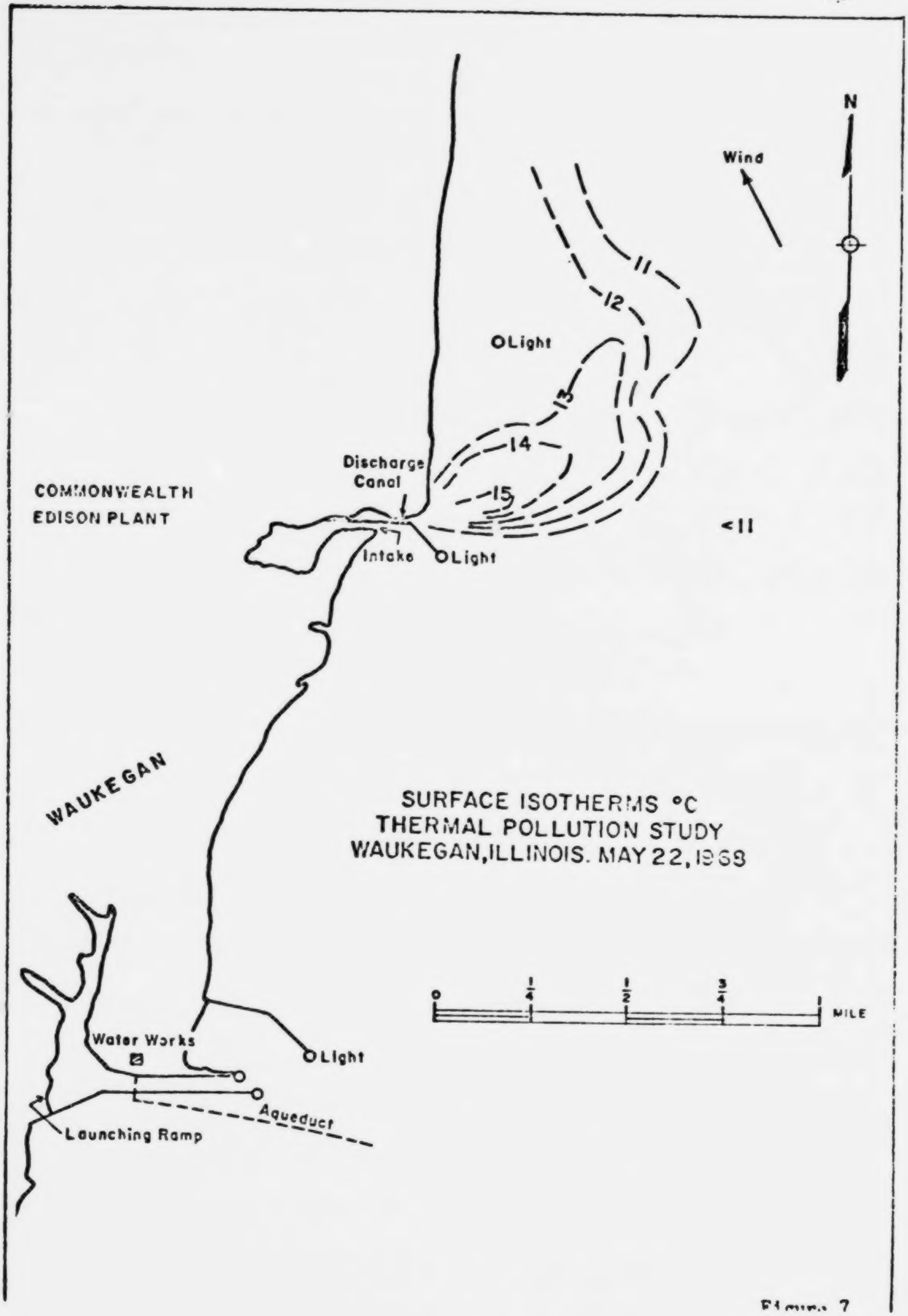
Wind was from the south-southeast. Figure 7 shows the results of these observations. The warm water extended about one-half mile offshore, and more than one mile north along the shore.

The cooling water discharge pattern at the Waukegan Plant also was observed by plant personnel during April 1968. The plant was discharging about 1,700 cfs of cooling water at a temperature of about 60°F. which was 12°F. above that of the lake water. The discharge from the plant was through a flume emptying at the shore with a velocity of 2.6 feet per second. The wind was generally in a southerly direction but varied from slightly east to slightly west of south, which made it approximately parallel to the shore. It was usually less than 10 mph. Figures 8 through 17 show the results of these observations in detail. The plume occupied a roughly circular area, about 0.3 miles in diameter at the surface with a center about 0.4 miles offshore. The center of the area was slightly north of the discharge point. The area was connected to the point of discharge by a neck less than 0.1 of a mile wide. The circular area decreased with depth, averaging about 0.1 of a mile in


Wind
5 M.P.H.
Ambient
65°
LAKE MICHIGAN
5' Depth
65.5°
65.5°
2.5' Depth
70°
65.5°
75°
70°
65.5°
Surface
65.5°
70°
83.5
75°
70° Intake
65.5°
Lake Shore Ave.
Location Map
J.H.
Campbell
Plant
N
Scale in Miles
0
1/2

THERMAL PLUME of J.H. Campbell Plant, Consumers Power Company
Port Sheldon, Michigan, July 3, 1968

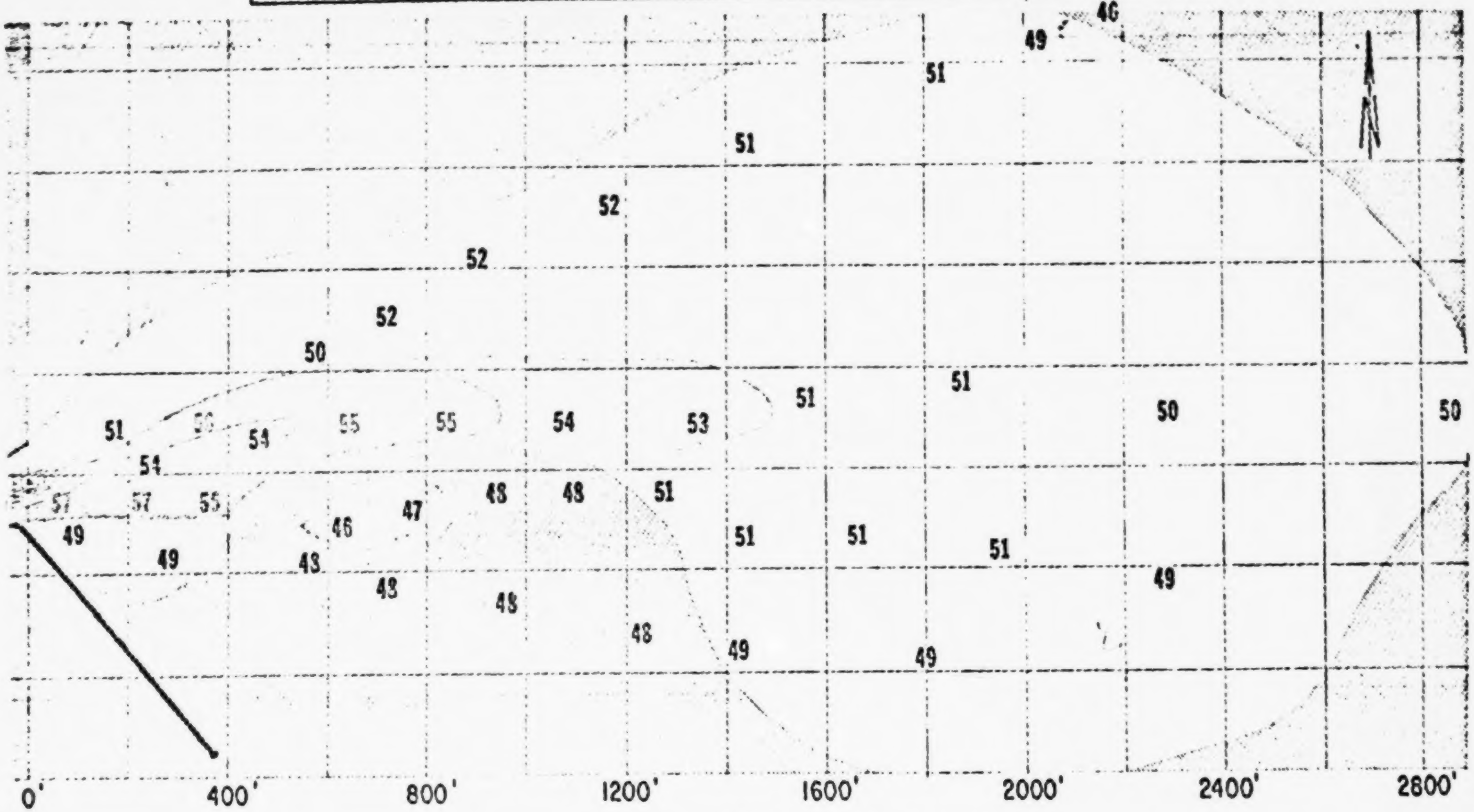
Figure 6


N
Wind
11
12
13
14
15
<11
OLight
Discharge Canal
COMMONWEALTH EDISON PLANT
Intake
OLight
WAUKEGAN
0
1/4
1/2
3/4
1
MILE
Water Works
OLight
Aqueduct
Launching Ramp

SURFACE ISOTHERMS °C
THERMAL POLLUTION STUDY
WAUKEGAN, ILLINOIS. MAY 22, 1968

Figure 7

TEMPERATURE STUDY -- WAUKEGAN STATION - APRIL 1968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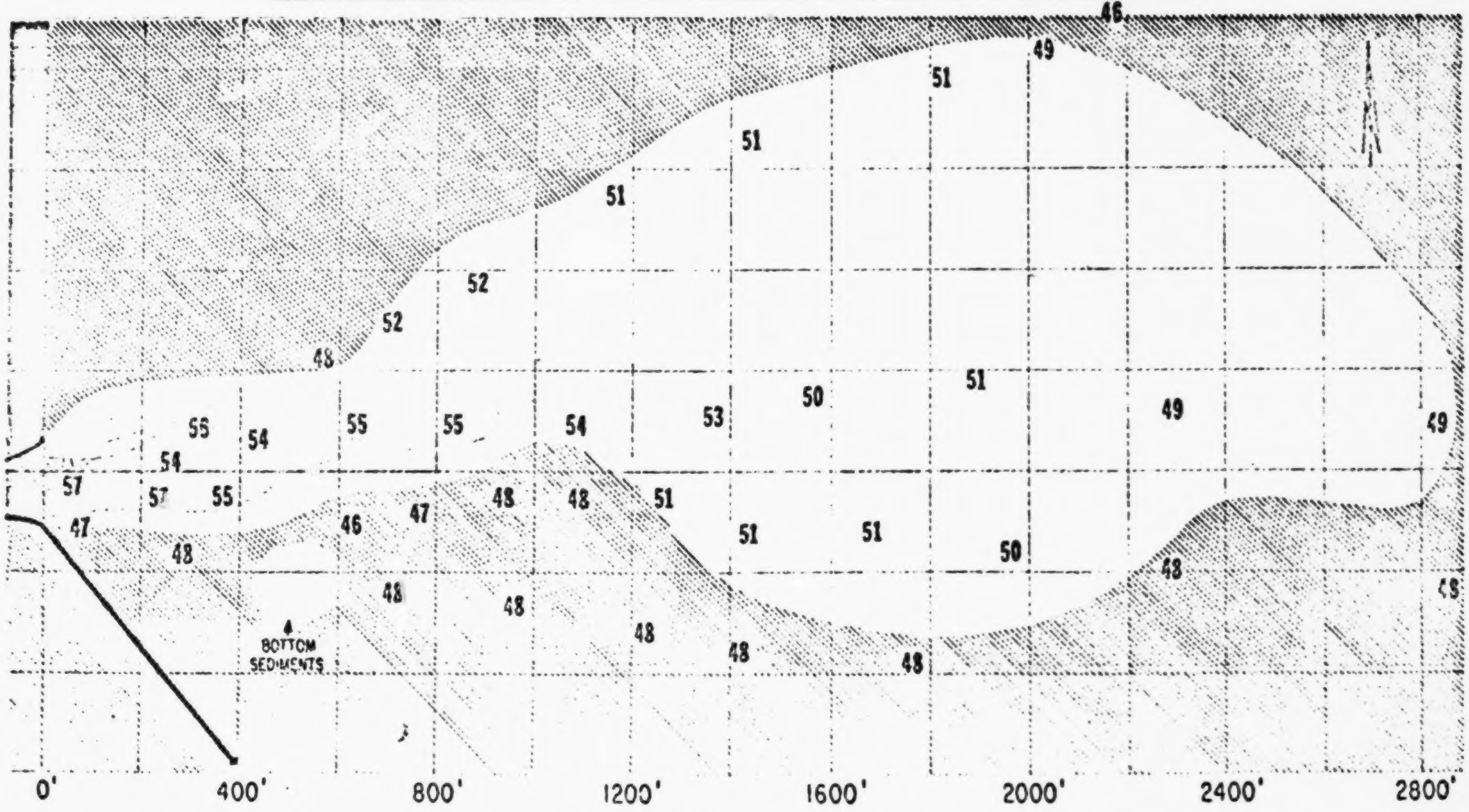
57
55
49
49
46
47
48
48
51
51
51
51
43
43
48
48
49
49
49
0'
400'
800'
1200'
1600'
2000'
2400'
2800'

FIG. 8 1' BELOW SURFACE

TEMPERATURE STUDY -- WAUKEGAN STATION - APRIL 1968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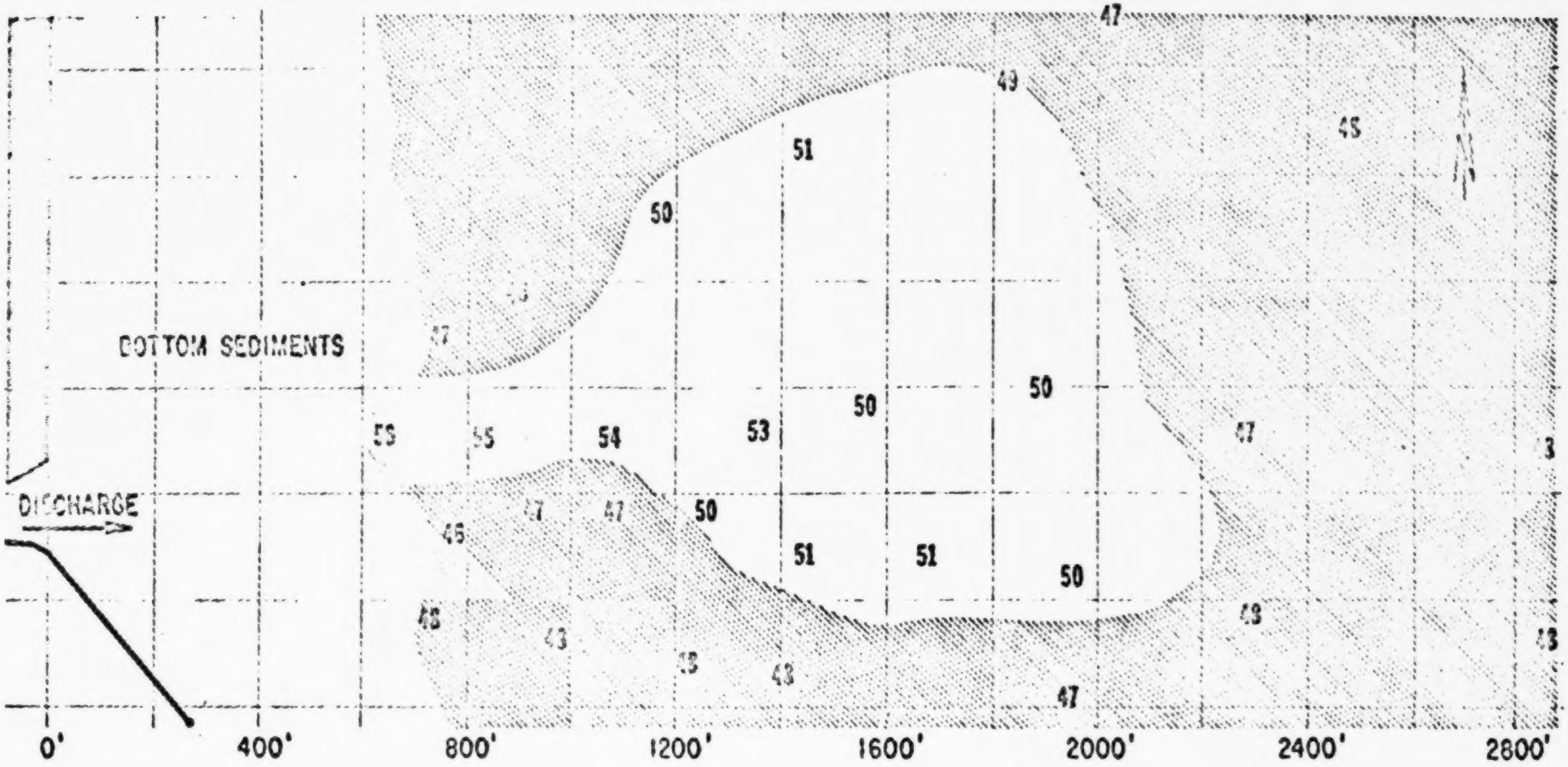
57
55
47
48
46
47
48
48
51
51
51
50
48
48
48
48
48
48
48
48
BOTTOM SEDIMENTS
0'
400'
800'
1200'
1600'
2000'
2400'
2800'

FIG. 9 4' BELOW SURFACE

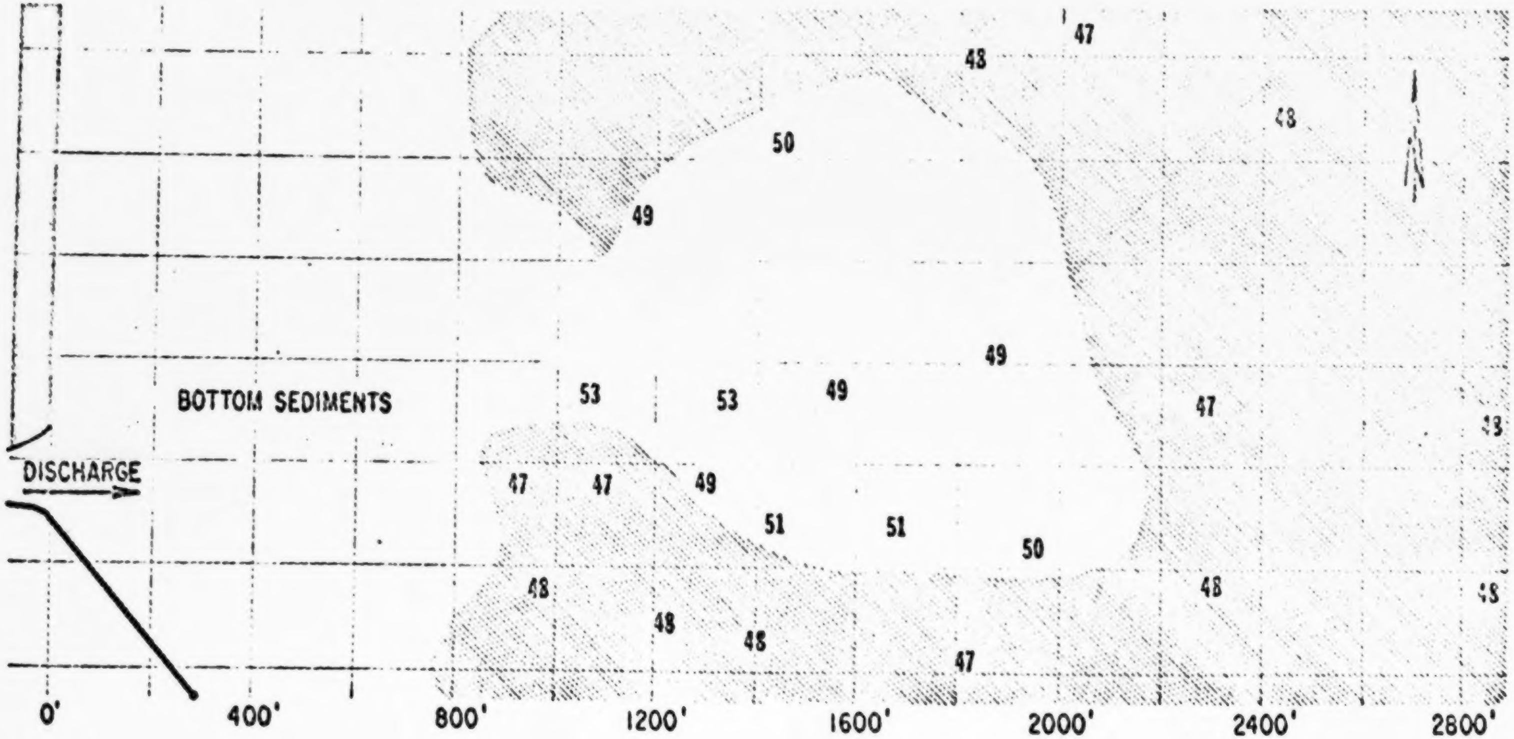
TEMPERATURE STUDY -- WAUKEGAN STATION · APRIL 1968



47
49
51
45
50
BOTTOM SEDIMENTS
47
50
50
55
55
54
53
50
47
DISCHARGE
45
47
47
50
51
51
50
48
43
43
43
43
47
43
0'
400'
800'
1200'
1600'
2000'
2400'
2800'

FIG. 10 8' BELOW SURFACE

TEMPERATURE STUDY -- WAUKEGAN STATION - APRIL 1963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48
50
48
49
49
BOTTOM SEDIMENTS
53
53
49
47
DISCHARGE
47
47
49
51
51
50
48
48
48
47
48
48
0'
400'
800'
1200'
1600'
2000'
2400'
2800'

FIG. 1-1 10'BELOW SURFACE

TEMPERATURE STUDY -- WAUKEGAN STATION - APRIL 1968

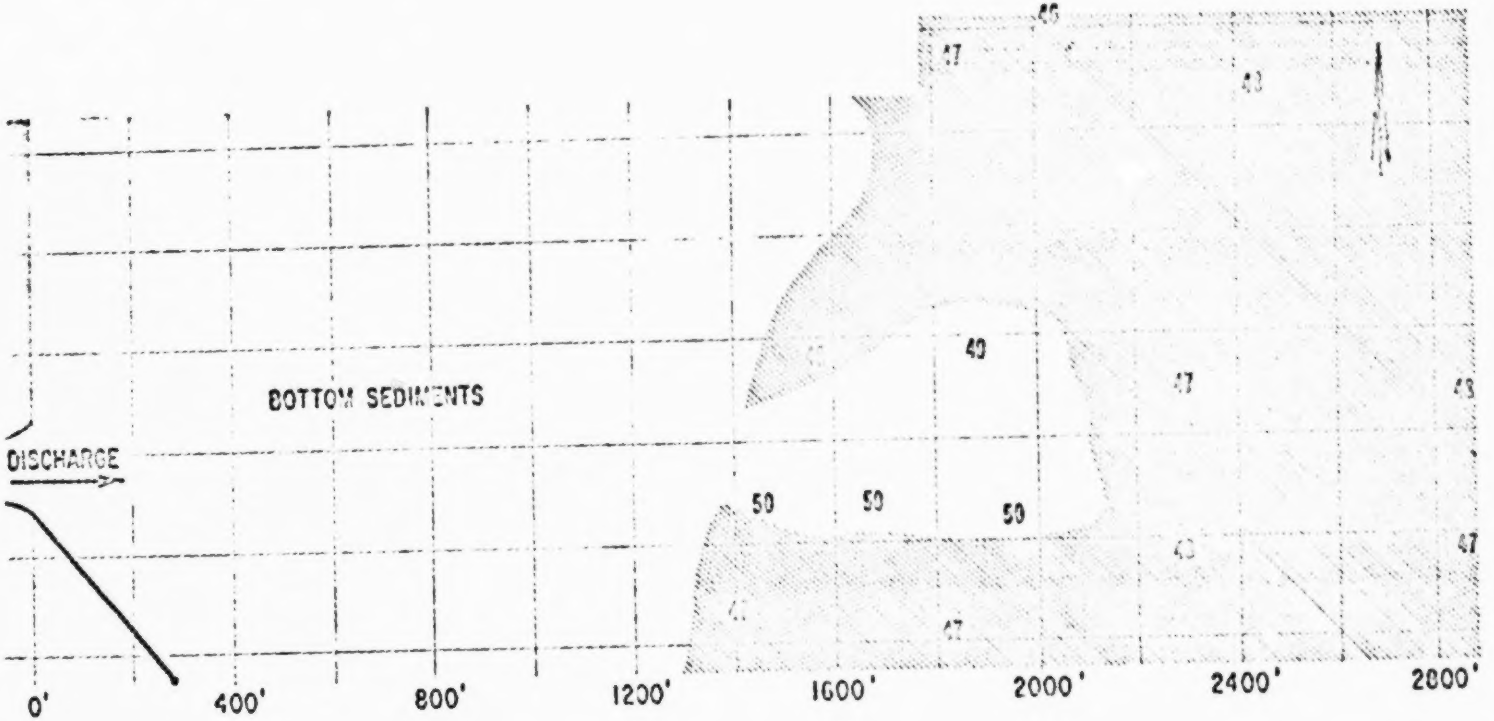

FIG.12 14'BELOW SURFACE

TEMPERATURE STUDY -- WAUKEGAN STATION - APRIL 1968

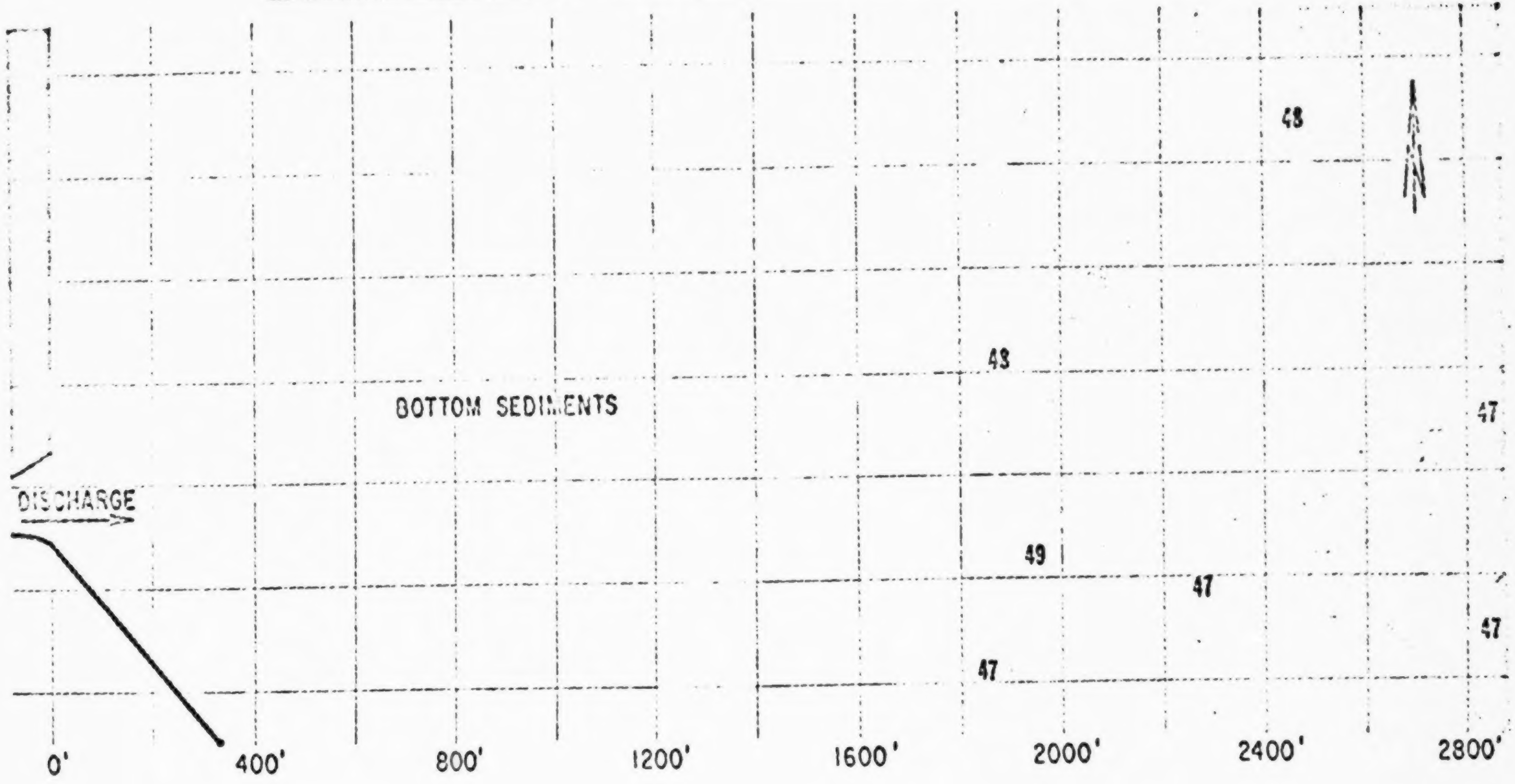

FIG. 13 18'BELOW SURFACE

TEMPERATURE STUDY -- WAUKEGAN STATION - APRIL 1968

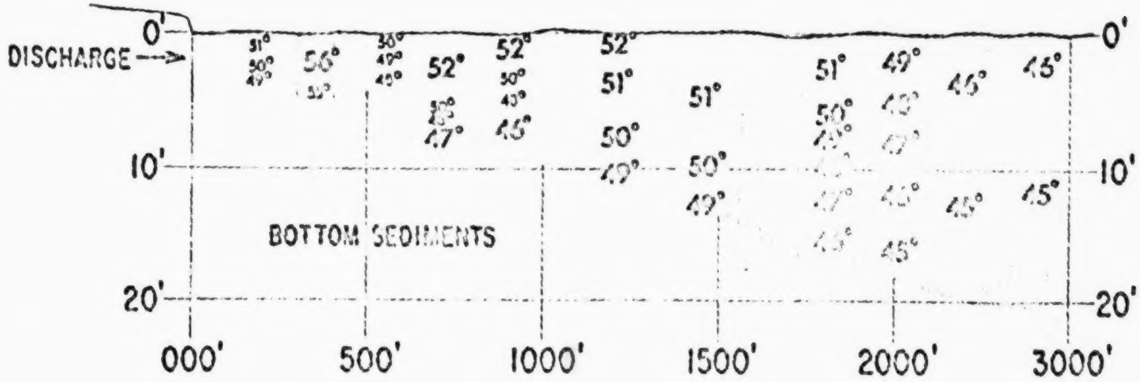

FIG. 14 NORTH EAST SECTION

TEMPERATURE STUDY -- WAUKEGAN STATION - APRIL 1968

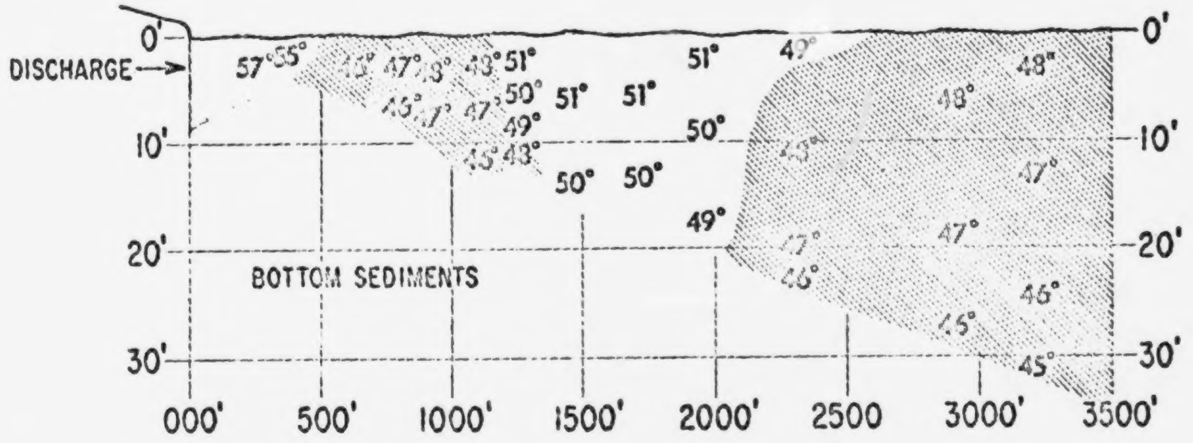

FIG. 15 EAST SECTION

TEMPERATURE STUDY ·· WAUKEGAN STATION · APRIL 1968

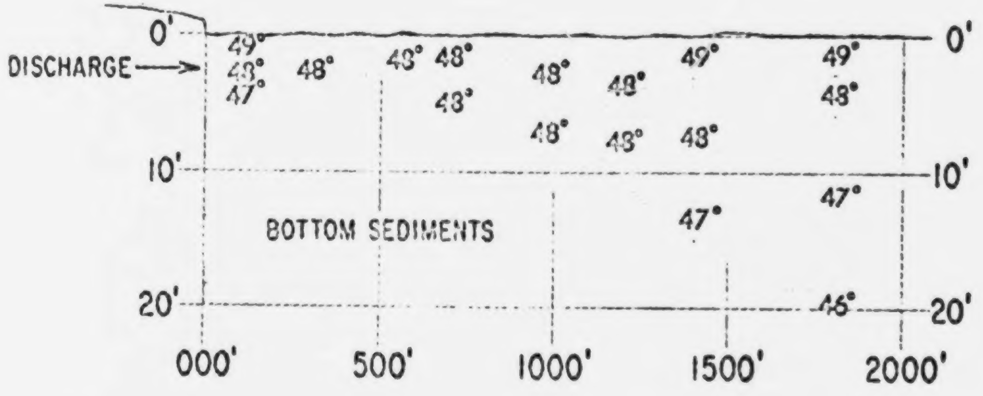
0'
DISCHARGE
10'
20'
49°
48°
47°
48°
48°
48°
48°
48°
48°
48°
48°
49°
48°
49°
48°
47°
47°
46°
BOTTOM SEDIMENTS
0'
10'
20'
000'
500'
1000'
1500'
2000'

FIG. 16 SOUTH EAST SECTION

TEMPERATURE STUDY -- WAUKEGAN STATION · APRIL 1968

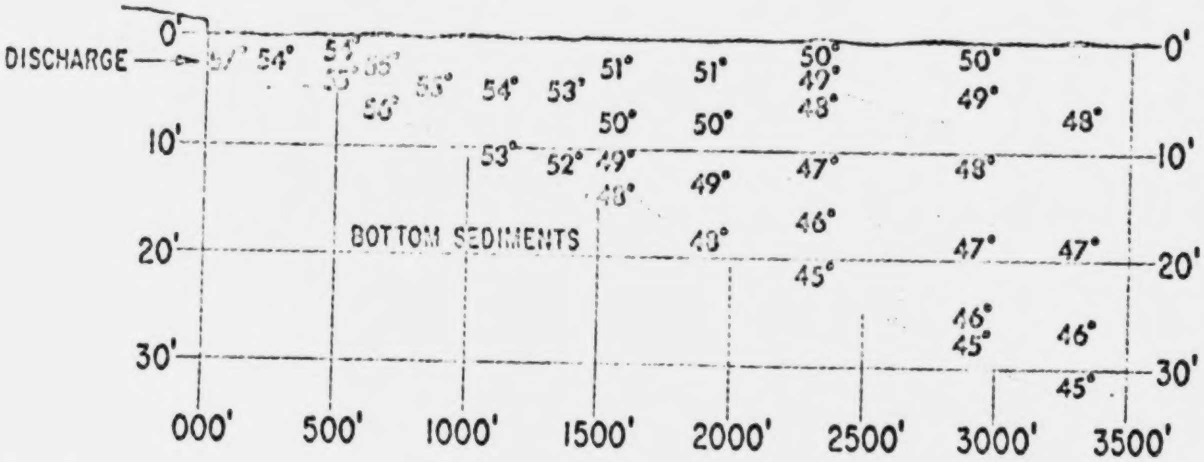
DISCHARGE
0'
10'
20'
30'
000'
500'
1000'
1500'
2000'
2500'
3000'
3500'
BOTTOM SEDIMENTS
54°
54°
53'
51°
51°
50°
50°
49°
48°
50°
50°
49°
49°
48°
53°
52°
49°
48°
47°
48°
48°
46°
47°
47°
45°
46°
45°
46°
45°

FIG. 17 EASTERLY DISCHARGE SECTION (RANDOM)

diameter at 14 feet. Part of the reduction in area was attributable to the sloping bottom of the lake, which extended about to the center of the warm water area at the 18 foot depth.

Information was obtained from Dr. John Edinger(6) on heated water discharged to the ocean. It was stated that 1,000 cfs of heated water, 10°F. above intake water temperature from a 1000 MW conventional steam plant discharged submerged from an open end pipe at a velocity of seven to eight feet per second was diluted ten times in the receiving water in a surface area of 200 acres (0.3 sq. mile). The temperature at the boundaries of the area was within 1°F. of the surrounding water temperature. The topography of the ocean bottom did not restrict free flow of diluting water to the discharge area. It was indicated that if the same quantity of heat was discharged with little mixing and temperature reduced by surface cooling alone, the heated water would occupy 2,300 surface acres (3.6 sq. mi.)

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(6) Personal Communication from Dr. John Edinger, Vanderbilt University, August and October 1968.

before the boundary temperature was within 1°F. of the surrounding water temperature. This would probably happen for discharges at less than 3.5 feet per second, but depends on many features of discharge design.

Although this situation involved ocean water, it is thought to be applicable to heated fresh water discharged to a large lake, since the main density difference in both cases would be caused by the difference in temperature between the cooling water and the receiving water.

The relatively unmixed plume would result if the cooling water disposal system were designed to discharge at low velocity and float the heated water on the surface with minimum mixing in order to achieve maximum evaporative cooling. In a lake, such as Lake Michigan, this method of disposal would entail the probability that the relatively unmixed heated water would be carried by wind action to the shore at times.

POTENTIAL EFFECTS ON WATER USES

The potential effects of the nuclear power plant wastes are considered on the basis of the lake as a whole and on that of local effects.

The Lake as a Whole

Radioactivity

The design of the radioactive waste treatment systems is such that it should be possible to hold the concentrations of radioactive materials in the cooling water, before any dilution, to one-tenth or less of the AEC requirement for the water at the boundaries of the exclusion areas.

A total activity of 49,000 curies mixed with the entire volume of the lake would be required to give a gross beta count of 10^{-8} uc/ml above background. Ten times as much, or 490,000 curies, would be required for a gross beta count of 10^{-7}uc/ml. It is estimated that the seven proposed plants probably will discharge about one curie of mixed activity, exclusive of tritium, per year. Nearly 1.5 billion curies of tritium would be necessary to exceed the MPC for this radionuclide.

Except for an accident at one of the plants there does not appear to be any cause for immediate concern as a result of the radioactive discharge from normal nuclear power plant operation as it may affect the lake as a whole. However, the increased size of the plants, the lack of experience with large reactors, the possibility of human error, the rupture of a pipe or even the possibility of deliberate sabotage justifies conservatism in the design and location of nuclear power plants. In a remote area the effect of a reactor accident could be largely economic, restricting the use of a moderate section of land and requiring the rebuilding of a damaged or destroyed plant. However, one serious nuclear accident on the shore of Lake Michigan, although highly improbable, could release large quantities of long-lived radioactive materials into Lake Michigan where it would be uncontrolled and could have very serious effects on future use of the lake. Such an event would require immediate evaluation and initiation of measures to protect public health and safety and the resources of the lake. A coordinated interagency effort in the event of such an unlikely occurrence is mandatory.

Waste Heat

Reasonably complete data are available for fossil fuel power plants around the southern basin of Lake Michigan, south of a line from Milwaukee across to Grand Haven, where most of the population, industry and power plants are located. The fossil fuel plants have a total power production capacity of 6,070,000 kwe. The proposed nuclear power plants around the southern basin will have a total capacity of 5,600,000 kwe.

Data on fossil fuel plants around the northern basin are incomplete. The existing plus proposed nuclear plants around the northern basin have a total capacity of 1,500,000 kwe. If it may be assumed that the ratio of fossil to nuclear fuel plants for the southern basin applies to the northern basin, there would be a total fossil fuel plant capacity of 1,630,000 kwe around the northern basin.

On this basis the fossil fuel capacity for this lake as a whole would be 7,700,000 kwe, and the existing plus proposed nuclear fuel capacity is 7,100,000 kwe.

Applying the heat losses in cooling water previously discussed, the fossil fuel plants operating at full capacity would discharge 300,000 billion BTU's per year to Lake Michigan and the nuclear fuel plants would discharge 388,000 billion BTU's per year for a total of 688,000 billion BTU's per year. Assuming none of the added heat to be lost from the lake during the year the temperature of the 10,800,000 billion pounds of water in the lake would be raised an average of a little more than 0.06°F. by the end of the year.

There would, however, be significant loss of the added heat by radiation, evaporation and other **means**. Any residual heat, though, could be cumulative. The annual average temperature of the lake would be increased by an amount that eventually would reach equilibrium when the higher temperature of the water caused additional annual heat loss by the lake as a whole that would balance the annual addition of residual heat in the cooling water.

Using an adaptation of the method for estimating heat losses from streams and ponds described by Velz and Gannon,(7) and assuming an annual average temperature of 50°F. for Lake Michigan, a very conservative estimate of the increase in annual average lake temperature at equilibrium caused by the existing fossil fuel plants and the existing and proposed nuclear fuel plants would be 0.05°F. or from 50°F. to 50.05°F.

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(7) "Forecasting Heat Loss in Ponds and Streams," C.J. Velz and J.J. Gannon. Journal Water Pollution Control Federation, Vol. 32, No. 4 (April 1960).

The method of calculation (see Appendix B) is such that any additional increase in annual average temperature of the lake caused by increased power production would be in direct proportion to the increase in heat added to the lake. If it be assumed that there will be about eight times the present plus proposed power production by the Year 2000, the annual average temperature of the lake would be increased by an estimated 0.4°F. (8 x 0.05°F) at that time to 50.4°F.

Available data indicate that there has been a 2°F. decrease in temperature of the lake in the past 80 years, presumably because of a long-term trend in weather conditions(8). Power production would have to be 40 times the present plus proposed capacity to cause an increase in average lake temperature that would equal the 2°F. decrease caused by natural circumstances. This power production capacity would not be reached until about the Year 2023, if the present rate of doubling every 10 years continued until then.

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(8) "The Climatology of Lake Michigan," John C. Ayers. Great Lakes Reserach Division, Publication No. 12, Institute of Science and Technology, the University of Michigan, Ann Arbor, Mich., 1965.

These conservative calculations show that there is minimum cause for immediate concern over possible adverse effects of heated wastes on the lake as a whole, but the potential long-term effects must be considered.

Local Effects

Although there is minimum cause for concern over effects of the power plant discharges on the lake as a whole within the foreseeable future, there must be consideration of possible effects on water quality and uses in the vicinity of power plant discharges.

There are several types of water uses within distances that will be reached by wastes containing radioactive materials and heat from nuclear power plants. Several municipal water plant intakes are within a few miles of proposed cooling water discharge points.

There likewise are bathing beaches within distances to which the warmer water may extend. Fish, and the aquatic life on which they depend for food, occur throughout the lake. Both sport and commercial fishermen go where the fish are. Pleasure boaters are limited in their travel about the lake only by shallow water and intermittent roughness. Ducks and geese are common in many areas of the lake at certain times of the year.

Municipal Water Supplies

Since it is anticipated that radioactive materials will be diluted in power plant cooling water to about one-tenth or less of the AEC 10CFR20 limit, which is based on the maximum permissible concentration in drinking water, and since the cooling water will receive several-fold dilution with lake water before reaching any municipal water supply intake, no adverse effect on this use is anticipated.

It is possible that temperature of the raw water for one or two of the closer water supplies may be increased by a few degrees at times. An increase in temperature could intensify taste and odor problems, but it is not believed that the increase will be sufficient to interfere with normal use of any municipal water supply.

Bathing Beaches

Radioactive concentrations reaching any bathing beaches will be far too low to cause any adverse effect.

Lake Michigan waters frequently are so cool, even in the middle of summer, that they are uncomfortable for bathing. It has been suggested that a benefit might be realized in some cases by controlled admission of at least some of the heated water from power plants to nearby bathing areas. The bathing season for certain beaches conceivably might be extended by this use of the heated water. In no case is it anticipated that excessive heating of nearby beaches will occur.

Commercial and Pleasure Boating

The only conceivably adverse effect on commercial and pleasure boating would occur if the heated wastes should cause excessive fog on the lake. This Committee believes that any potential hazard to boating because of this would be minimal.

Fish, Other Aquatic Life, and Wildlife

No adverse effects on ducks and geese are anticipated by either radioactive materials or heated water.

Aquatic life of the lake is the factor most apt to be affected by waste heat.

It is possible that some of the radioactive materials in the cooling water could be concentrated successively in the food chain of aquatic life on which fish depend, and in the fish themselves to become a radiation hazard to humans who eat Lake Michigan fish regularly and frequently. The experience of the Illinois Sanitary Water Board with the boiling water reactor power plant at Dresden on the Illinois River, of the Wisconsin Department of Health and Social Service with the LaCrosse boiling water reactor on the Mississippi River, and that of the Michigan Water Resources Commission with the Big Rock Point boiling water reactor on Lake Michigan, indicate that any such probability is extremely remote. Of course, these plants are much smaller than those planned for Lake Michigan, and it will be necessary to monitor the aquatic life of areas adjacent to the new power plants before this preliminary conclusion can be verified. The AEC has confirmed the need for such evaluation:(9)

> "The dilution, dispersion, and transport of liquid radioactive wastes in surface waters (rivers, lakes, estuaries, bays and open ocean) are important factors in the siting of nuclear reactors. In addition to these phenomena, attention frequently needs to be directed toward biological concentration of radionuclides in aquatic life. It may be desirable to review previous work on this subject, including related research on discharge of municipal and industrial liquid wastes. Preparation of a state of the art review of current knowledge, and delineation of areas where further research is needed, would be useful. A special evaluation of the impact of siting many reactors on the shores of the Great Lakes, in relation to

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(9) AEC News Release No. IN-725 (Oct. 25, 1966).

retention and flushing characteristics and to accumulation of radionuclides in aquatic organisms, may also be desirable."

A more probable adverse effect is destruction or serious alteration of the aquatic life on which fish feed and possibly the killing of fish or interference with their normal spawning and growth if excessive temperatures of lake water occur.

The effects of localized temperature increases on the aquatic life in Lake Michigan are impossible to predict from the limited information available. Only a few observations have been made to date of the effects of existing thermal discharges on Lake Michigan biota. However, laboratory investigations and observations elsewhere suggest that increases in temperature can result in damage to the aquatic environment.

Temperature may activate and stimulate living things, but it also can depress, restrict, control or even kill them. It is one of the most important of water quality characteristics. Temperature strongly influences the existence of particular species in water, it activates spawning and hatching of fish, regulates their activity and stimulates or suppresses their growth and development. Heated water can attract fish and they may be killed when water becomes heated or chilled too suddenly. Colder water usually suppresses development. Warmer water generally accelerates activity and can be a primary cause of aquatic plant nuisances when other factors are suitable.

Temperature changes in water affect relationships among organisms, processes of natural purification, and growth and survival of bacteria. Biological reaction rates increase as water is warmed. An insect nymph in artificially warmed water, for example, might emerge for its mating flight too early in the spring and perish in the cold air, or a fish, under similar artificial conditions, might hatch too early in the spring and starve before its natural food developed. Organisms in water that rarely is warmer than 70°F. are subject to stress by, and may even die in, 90°F. water. Even at 75 to 80°F. they may not be able to compete successfully with organisms for which this temperature range is favorable.

As water temperatures increase, green algae may replace diatoms as the predominant algae, and at high temperatures these may in turn be replaced by blue-green algae. Cairns(10) found that diatoms from an unpolluted stream generally grow best at 64.4 to 86°F. Blue-green algae often cause severe visual and olfactory nuisances, and some species can be toxic to animals.

One of the green, filamentous, attached algae, Cladophora, already grows rather prolifically in certain areas of Lake Michigan, and it might be stimulated to nuisance proportions in warmer water. It has been observed in the laboratory that optimum growth of Cladophora occurred at 81 to 86°F.

The numbers and kinds of bottom organisms that serve as food for fish decrease as temperatures increase above 90°F., which is close to the upper limit for a balanced population. However, if temperatures are held to moderate levels, the numbers of bottom organisms are more apt to be increased than decreased by some increase in temperature.

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(10) Cairns, John, Jr., "Effects of Increased Temperature on Aquatic Organisms," Ind. Wastes, 1, 4, 150-152 (1956).

In spite of the known adverse effects which temperature change can have on aquatic life, it is not certain that they will occur in the unique environment of Lake Michigan. Much of the shoreline is seldom inhabited by aquatic animals because the bottom materials consist of shifting sand. There are rocky shoals that support game fish population. Whether or not local increases in temperatures will accelerate the eutrophication of Lake Michigan is uncertain at present. It is tempting to speculate on this but only intensive long-term studies will reveal the facts. Local increases in algal growth very probably will develop if sufficient nutrients are available, since biological activity is greater in warmer than in cooler water. The magnitude of these increases must be known before there can be evaluation of the potential problem.

Fish are attracted to warm water in the winter and fishing may be more successful in such areas than in adjacent colder areas. If the temperature difference is too great, however, the fish may be killed on return to the cold water, since they are more susceptible to sudden chilling than to sudden warming. Temperatures lethal to fish may result from heated discharges in summer. Lethal temperature levels vary rather widely with different species, and vary to some extent within a species in relation to previous acclimatization.

TVA has had a long and varied experience with discharge of heated water to reservoirs. Their personnel report no known case of fish kills because of return of fish from warm to cold water, and only one fish kill because of excessively warm water. The latter case occurred when added electrical capacity was brought into operation on a stream that was too small for the added heat load imposed on it. Cooling towers now are being constructed at this plant.

A more subtle effect on fish may be interference with spawning and hatching if temperatures vary much above natural levels which occur in spawning areas during normal spawning periods. It has also been suggested that increasing temperatures may block the migration of fish or cause them to avoid inshore waters;

thus making them less accessible to fishermen.

Atmospheric Effects

Since no cooling towers are included in plans for the proposed nuclear plants, the effects on atmospheric conditions will be minimal. There may be some local fog formation over the lake and adjacent land in the vicinity of the cooling water discharges. The more rapid the mixing and cooling of the warm water with the lake water, the less will be the probability of fog formation.

If cooling towers should become necessary in the future, it is reported that fog at ground level, and accompanying icing of adjacent surfaces can be controlled by proper cooling tower heights. Further investigation of this feature by persons specializing in meteorology is needed before the range of necessary tower heights can be specified. This probably will involve advanced investigation of local atmospheric conditions.

CRITERIA

Three sets of criteria, standards or regulations are of interest in considering nuclear power plant wastes. They include: The States standards for temperature and radioactivity; the water quality criteria for temperature and radioactivity recommended by the National Technical Advisory Committee to the Secretary of the Interior; and the AEC rules and regulations for the disposal of radioactive wastes to the environment.

States

The States standards for temperature are given in Table 2 and for radionuclides in Table 3.

Temperature standards

The limit on maximum temperature for protection of aquatic life in Lake Michigan adopted by two of the States, Illinois and Indiana, is 85°F. Wisconsin permits a maximum of 89°F. in shore waters near waste discharges and in harbor waters. All States allow a reasonable distance for mixing. The maximum limits for the three States with numerical limits appear to be quite similar, depending on administrative interpretations of allowable mixing zones.

Illinois and Wisconsin have modifying requirements that may limit temperatures to less than the 85°F. maximum. Illinois does not permit changes in temperature greater than 2°F. per hour nor cumulative changes greater than 5°F. from natural water temperatures. Wisconsin permits no abrupt change of more than 5°F., nor an increase in a stream of more than 3°F. above the natural maximum.

Indiana does not have such modifying requirements. Michigan has no numerical limit on temperature for Lake Michigan but bases control of heated discharges on abatement or prevention of injuries caused by such discharges.

Of the standards proposed by the States, those of Michigan have not been approved by the Secretary of Interior.

It is obvious that variations in enforcement of the State standards are possible.

Radionuclides Standards

All four States base radionuclide limits on the Public Health Service 1962 Drinking Water Standards. Three of them incorporate the PHS standards by reference, but Michigan paraphrases a portion of the standards (Section 6.22). The Wisconsin standard, based on PHS standards, is specified for public water supplies, and

TABLE 2

TEMPERATURE STANDARDS

ILLINOIS		
Approved	Lake Michigan	Shorewater not more than 85°F.
		Open water not more than 85°F.
	(all uses)	Changes in temperature not to exceed 2°F. per hour, nor more than 5°F. cumulative change from natural water temperature.
INDIANA		
Approved	Lake Michigan	Shorewater not more than 85°F.
		Open water not more than 85°F.
	(all uses)	Inner harbor basin not more than 85°F.
MICHIGAN		
Not Approved	Great Lakes and connecting waterways	No heat load in sufficient quantity to create conditions which are or may become injurious to the public health safety or welfare; or which are or may become injurious to domestic, commercial, industrial, agricultural, recreational or other uses which are being or may be made of such waters; or which are or may become injurious to the value or utility of riparian lands; or which are, or may become, injurious to livestock, wild animals, birds, fish or aquatic life or the growth or propagation thereof.

TABLE 2
(contd)

TEMPERATURE STANDARDS

WISCONSIN		
Approved	Fish and other aquatic life (where this use is of primary importance)	84°F max. (Lake Michigan open water). No change from natural unpolluted background by more than 5°F. at any time nor at a rate in excess of 2°F. per hour.
	Combined uses (warmwater fish)	89°F. max. (Lake Michigan harbor areas and shore near waste discharges). No abrupt change of more than 5° F. Authorization must be obtained for thermal pollutants which may increase the natural maximum temperature of a stream by more than 3°F.

Trout waters not to be altered from natural background by effluents which would adversely affect trout populations in any manner.

TABLE 3

RADIONUCLIDE STANDARDS

ILLINOIS	Lake Michigan	(Open water and shorewater) Shall not be present in concentrations that will prevent meeting PHS 1962 Drinking Water Standards after conventional treatment. (All waters) Where intake results from the occurrence of radioactive materials--in drinking water--the average concentrations of radionuclides in the --drinking water--averaged over any 13 consecutive weeks shall not exceed the maximum permissible concentrations in Illinois Rules and Regulations for Protection Against Radiation Hazards. (Effluent criteria) Gross beta activity in the known absence of more than 3 pc/1 alpha emitters and more than 10 pc/1 Strontium-90 not to exceed 1,000 picocuries per liter at any time.
INDIANA	Lake Michigan	(Open water, inner harbor basins, and shorewater) Shall not be present in concentrations that will prevent meeting PHS 1962 DrinkingWater Standards after conventional treatment.
MICHIGAN	Great Lakes	(For water supply and agricultural uses. Standards to be established for other uses as information becomes available) An upper limit of 1,000 picocuries/liter of gross beta activity (in absence of alpha emitters and Strontium-90). If this limit is exceeded, the specific radionuclides must be identified by complete analysis in order to establish the fact that the concentration of nuclides will not produce exposures above the recommended limits established by the Federal Radiation Council.

TABLE 3
(contd)

RADIONUCLIDE STANDARDS

WISCONSIN	Lake Michigan	(Open water - water supply) The intake water supply shall be such that by appropriate treatment and adequate safeguards it will meet the PHS 1962 Drinking Water Standards. (All waters) The U. S. Atomic Energy Commission Rules and Regulations, Title 10, Part 20, Standards for Protection Against Radiation, December 22, 1965, will apply to the disposal and permissible concentrations of radioactive substances

it applies AEC 10CFR20 limits to all water uses. The Michigan standards apply to municipal water supply and agricultural uses only. The Indiana and Illinois standards apply specifically at municipal water supply intakes only, in open water and inner harbor basin, and to bathing beach areas only in shore waters, but presumably would be applied anywhere to a heated discharge.

Atomic Energy Commission

The AEC responsibility for waste disposal in licensing nuclear power plants presently is limited to safe disposal of radioactive wastes, and does not extend to control of waste heat.

Radionuclide Regulations

The AEC requirements for control of radionuclides discharged to surface waters are included in the U. S. Atomic Energy Commission Rules and Regulations, Title 10 - Atomic Energy, Part 20, "Standards for Protection Against Radiation," which has been abbreviated to 10CFR20 in most references. This regulation covers not only safe liquid waste disposal but is designed to afford protection against all radiation hazards of all persons that could be affected by the use of radioactive materials licensed by AEC.

Applications for licensing nuclear power plants usually state that waste disposal will meet the requirements of 10CFR20, without specifying what the requirements are.

The basic requirement is that the sum of the individual radionuclide concentrations in the liquid wastes divided by their individual limiting concentrations not exceed 1.0:

$$\frac{C_1}{(MPC_w)_1} + \frac{C_2}{(MPC_w)_2} + \frac{C_3}{(MPC_w)_3} \ldots \frac{C_i}{(MPC_w)_i} = < 1.0$$

where:

C = annual average concentration of the individual radionuclide

MPC_w = 10CFR20 concentration limit for the individual radionuclide.

Table 2, Column 2 of Appendix B, 10CFR20, lists the MPC_w of all common radionuclides. The concentration limits are based on the recommendations of the National Council on Radiation Protection and Measurements and of the Federal Radiation Council.

The determination of all radionuclides

in the wastes from a nuclear power plant would be time consuming and expensive, and 10CFR20 contains an alternate requirement. This limits the gross radioactivity to 10^{-7} μc/ml (100 pc/l) above natural background as an annual average, provided that Iodine-129 and Radium-226 and -228 are known to be absent from the wastes. Generally adherence to the 10CFR20 limit for unidentified radionuclides will necessitate a smaller total release of radionuclides than that which would be permitted if the identity and concentration of each radionuclide in the mixture were determined.

The limits of the permissible radionuclide concentrations must be met at the boundary of the nuclear power plant "exclusion" area. This usually means that the limits apply to the waste discharge.

The 10CFR20 gross radioactivity limit of 10^{-7} μc/ml is one-tenth of the PHS Drinking Water Standard gross beta count of 1,000 pc/l, but the latter specifies that Strontium-90 must be absent, which the former does not. For this reason the two limits on gross beta counts are not directly comparable.

The AEC concentration limits are directed toward protecting individuals in the general population from exposure to radiation as a result of intake of radioactivity through air and water. In addition to these limits on concentrations in effluents, the AEC may impose limits on the gross quantity of radioactive material released in air or water in a specified period of time if it appears likely that the daily intake of radioactive material from air, water and food by a suitable sample of the exposed population group exceeds the daily intake that would result from continuous exposure to air or water containing one-third the concentration of radioactive material specified for effluents.

FWPCA Committee on Water Quality Criteria

Temperature Criteria

The report of the Committee on Water Quality Criteria(11) published April 1, 1968, recommends temperature limits for several water uses. Briefly summarized, they are:

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(11) "Water Quality Criteria, Report of The National Technical Advisory Committee to the Secretary of the Interior," Federal Water Pollution Control Administration, Washington, D. C. (April 1, 1968).

1. In primary contact (recreation) waters, temperature should not exceed 85°F.

2. For aquatic biota, including fish:

a. Temperature of the epliminions of lakes should not be raised more than 3°F.

b. Normal daily and seasonal fluctuations should be maintained.

c. The following maximum temperatures for various species of fish are recommended:

93°F. Growth of catfish, gar, white or yellow bass, spotted bass, buffalo, carpsucker, threadfin shad, and gizzard shad.

90°F. Growth of largemouth bass, drum, bluegill, and crappie.

84°F. Growth of pike, perch, walleye, smallmouth bass, and sauger.

80°F. Spawning and egg development of catfish, buffalo, threadfin shad, and gizzard shad.

75°F. Spawning and egg development of largemouth bass, white, yellow, and spotted bass.

68°F. Growth or migration routes of salmonids and for egg development of perch and smallmouth bass.

55°F. Spawning and egg development of salmon and trout (other than lake trout).

48°F. Spawning and egg development of lake trout, walleye, northern pike, sauger, and Atlantic salmon.

Radionuclide Criteria

The recommendations of the Committee on Water Quality Criteria for limits on radionuclides in sources of municipal water supply are the same numerical values for gross beta activity and for Radium-226 and Strontium-90 as the PHS Drinking Water Standards.

The criteria for radionuclides in water serving as a habitat for aquatic life incorporate the PHS Drinking Water Standards, but also limit concentrations to less than those that would require restrictions on use of organisms harvested from the area in order to meet the Radiation Protection Guides recommended by the Federal Radiation Council. Finally, there should be no radioactive materials in receiving waters as a consequence of failure of an installation to exercise practical and economical control to minimize release.

Criteria for essentially all other water uses are based on the PHS Drinking Water Standards, specifying limits of 3 pc/l for Radium-226, 10 pc/l for Strontium-90, and 1,000 pc/l for gross beta activity in the known absence of Strontium-90 and alpha-emitting radionuclides.

EVALUATION OF PROPOSED WASTE DISPOSAL

Radionuclides

Applications to AEC for licenses for installation and operation of nuclear power plants state that methods for disposal of radioactive materials will be in compliance with AEC 10CFR20. In fact, it generally is indicated that the concentrations of radionuclides in the cooling water discharge will be only 10 to 20 percent of the appropriate 10CFR20 limits. Compliance with 10CFR20 will ensure compliance with the standards of those States that have adopted the PHS Drinking Water Standards for radionuclides.

The only adverse effect that might result from routine operation is the possible concentration of radionuclides through the aquatic food chain to fish that would be consumed by humans. This possibility is believed to be remote, but it is a matter that should be investigated in the vicinities of the first large plants that are installed.

More adverse conditions could occur in the event of neglect or accident in operation of disposal facilities. The present practice of continuous monitoring of the cooling water discharge is essential to detect any unusual discharges of radionuclides that might occur. The AEC and the power industry have contingency plans in case of major accidents involving release of radioactivity. There is a need to develop a plan for full coordination of other Federal, State and local agencies having competence in this area.

In keeping with the policy of the States and AEC of minimizing the discharge of radioactivity to the environment to the greatest practical extent, the Committee believes that all reasonable steps should be taken to reduce radioactive wastes as much as possible. Methods of waste reduction include detention for decay, sedimentation, filtration, demineralization, evaporation, and recycling to the primary coolant. Solid wastes are disposed of off-site in accordance with AEC regulations.

Heat

The adequacy of proposed methods for disposal of heated cooling water is subject to more questions and involves more uncertainty than does that of disposal of radionuclides.

Most of the proposals involve withdrawal of relatively cool (about 65°F. in the summer) water from the lake at some distance from shore and return of the water at about 85°F. near shore either through a dug channel discharging at the shoreline, or through an appurtenance that will release the water a short distance from shore. The standard would be met either by limiting the temperature of the cooling water to that of the standard, or by taking advantage of a specified mixing zone allowance, with the temperature of the mixed cooling and lake water meeting the standard at the boundaries of the mixing zone.

Available information on the potential impact of large volumes of cooling water on large lakes does not provide a sound basis for firm conclusions regarding adequacy of proposed methods of disposal or of possible adverse effects on Lake Michigan.

It appears that no issue can be taken with those proposals that would maintain the maximum temperature of the cooling water, before discharge to the lake, at the temperature of the standards. Even here, however, there conceivably could be limited adverse effects such as production of excessive plankton and attached algae, and interference with the spawning, hatching and development of certain species of fish. The latter could occur if the cooling water maintained the temperature of water in breeding areas at 85°F., or even less, at critical times in the life cycle of fishes.

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Alternative Methods of Disposing of Heated Wastes

The method of heat disposal that would have least impact on even limited areas of the lake would be the use of evaporative cooling towers, ponds or other methods of off-lake cooling to reduce the temperature of the water to or very near that of the shore waters of the lake. This would involve loss of water from the lake by evaporation.

The nuclear power plants generally are larger than any existing fossil fuel plants and require considerably larger quantities of cooling water. The Zion plant, for example, when completed will use an annual average of 2,940 cfs, with a maximum of 3,400 cfs in summer. Of all the rivers tributary to Lake Michigan only the Fox River in Wisconsin has an average annual flow significantly greater than the Zion summer cooling water use. If all proposed plants used water for cooling at the same rate in relation to production capacity as the Zion plant, the average use would be 9,500 cfs. The proposed power capacity plus that predicted by 1980, if all should be nuclear power, could use 17,500 cfs. Maximum use during summer by 1980 could be 20,000 cfs.

If evaporative cooling towers should be found necessary by then and resulted in two percent loss of water through evaporation, this would result in evaporation of 400 cfs during summer. Of course, there will be some evaporative loss even if immediate dispersion into the lake is used, but it would be considerably less than 400 cfs. By the Year 2000, evaporation could be 1,600 cfs if power production continued to double and evaporative cooling towers were necessary on all installations.

Dry cooling towers permit cooling without evaporation. They are designed to transfer heat by air cooling and radiation.

Two different methods of heated water discharge without off-lake cooling have been discussed by the Committee. A method that would have minimal impact on water quality and uses would be the submerged discharge of the cooling water at velocity high enough to ensure rapid mixing, and far enough from shore to be beyond the thermal bars that probably partly account for the reported tendency of discharges near shore to remain in the vicinity of the shore. It is reported that 1,000 cfs of seawater, with a temperature 10°F. above that of the ocean, discharged from the open end of a pipe at a velocity of 7 to 8 feet per second was diluted to 10 times its volume in 200 acres of the ocean surface. It is believed that similar dilution might be accomplished in the lake. This would minimize evaporative cooling and would involve an average increase of 2°F. to 3°F. in the temperature of a relatively large volume of lake water.

The other method would involve low velocity discharge with as little mixing as possible, allowing the cooling water to float on the surface of the lake in order to take advantage of as much evaporative cooling as possible. It is reported that 1,000 cfs of warm ocean water 10°F. above ocean water temperature discharged to the ocean in this manner would occupy 2,300 acres of the ocean surface. The total volume of lake water in which a temperature rise would occur if this method were used would be minimal, and heat added to the lake as a whole would be minimized. This method would involve the certainty, however, that there would be times when the heated water would be carried by wind action to shore where the greatest damage to aquatic life could occur.

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The Committee has not considered the costs of cooling devices or of submerged discharges with rapid mixing. However, it realizes that either of these methods would be costly and recommendation that one or the other be routinely required for all power plants would have to be supported by firm information on damages to water quality and uses that would result from failure to require such devices. Available information on potential damages does not provide a basis for such a position at this time. Such information can be obtained through studies by aquatic biologists of areas in Lake Michigan where large fossil fuel plants presently discharge large quantities of cooling water.

It is probable that the time will come when more sophisticated methods of disposing of the waste heat than merely discharging it to the lake at the shoreline will become necessary. Now is the time to start accumulating sound information on which to base decisions regarding requirements for future disposal of the waste heat.

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Other Wastes

The Committee has not evaluated disposal of wastes other than radionuclides and heat.

STUDY PLAN

Data on the effects of heated waste discharges to Lake Michigan are needed. Examination of the effects of existing large fossil fuel plants on water quality and uses can go far toward providing the necessary information on effects of heated wastes on aquatic life, which appears to be the potentially crucial aspect of heated waste discharges.

In addition to studies of effects of existing fossil fuel plants there is need for collection of baseline data on present water quality and aquatic life in the vicinities of future nuclear power plants. An outline of a plan for such studies is presented in the Appendix.

Some studies already are under way in the vicinities of some of the proposed plants. The power companies have contracted for or are conducting most of this work; but the States, consultants, and FWPCA also are involved to some degree. There is a need for coordination and possible expansion of the work now in progress.

SUMMARY AND CONCLUSIONS

Following the Conference on pollution of Lake Michigan and its tributary basin in early 1968, a Committee was formed by the Conferees to consider the disposal of thermal and radioactive wastes from nuclear power plants to be located on Lake Michigan.

One existing and six proposed nuclear power plants with an electrical production capacity of 7,100,000 kilowatts will be in operation on the shores of Lake Michigan within the next decade, with all but one scheduled for completion by 1973. This proposed capacity probably will be only a little less than the estimated 7,700,000 kwe existing fossil fuel power plant capacity.

Since the turn of the century, thermal power plant production throughout the Nation has approximately doubled every 10 years. It is anticipated that the availability of a large source of cooling water in

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Lake Michigan and the expanding industries on its shores will support an even greater increase in power production in this area than the national average. Most of the increased capacity probably will be in nuclear power plants.

The AEC predicts that there will be need for an additional 6,000,000 kilowatts of electrical capacity on Lake Michigan by 1980.

Existing fossil fuel plants operating at full capacity discharge an estimated 300,000 billion BTU's per year in cooling water to the lake. Nuclear reactor power plants discharge 40 to 50 percent more waste heat per unit of electrical production to the cooling water than do fossil fuel plants, and it is estimated that the 7 nuclear plants when in full operation will discharge 388,000 billion BTU's per year to the lake. If all plants, both existing and proposed operated at full capacity for a year, and if there were no reduction of the added heat through evaporative cooling and other means, and assuming complete mixing of the entire lake, the temperature of the lake would be raised a little more than 0.06°F. annually.

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The foregoing calculation assumes no reduction in the heat of the cooling water added to the lake, but actually there will be much reduction through evaporation, radiation and other means. There will, however, be a residual of the added heat that will be cumulative until an equilibrium is reached at a somewhat higher temperature than that due to natural causes. It is estimated that with an average annual temperature of 50°F. for the lake the added heat would raise the average annual temperature at equilibrium by 0.05°F. to 50.05°F. With increasing power production and no off-lake cooling, it is estimated the average annual temperature would be increased by 0.4°F. in the year 2000, and by 2.0°F. in 2023. This increase would nullify a 2.0°F. decrease in average annual temperature of the lake that has occurred, apparently from natural causes in the past 100 years.

These conservative calculations indicate that there is minimum need for immediate concern over the effect of temperature on the lake as a whole. The probable long-range effect deserves consideration.

Possible local effects of increased

temperature on aquatic life, including fish, are cause for more **immediate** concern than the effect on the lake as a whole. Fish and the aquatic organisms that serve as their food are particularly sensitive to variations in seasonal temperature during reproductive and juvenile stages. For example, abnormally high temperatures during the spawning and hatching season may completely upset the normal reproductive cycle of fish, and thus limit or prevent their production. It also is possible that increased temperature of lake water locally may stimulate undesirable growths of plankton and filamentous algae, and lead to production of nuisances.

Of the four States bordering the lake, Illinois and Indiana have temperature standards, approved by the Secretary of the Interior, that require that the maximum temperature of Lake Michigan water not exceed 85°F. after reasonable allowance for mixing. The Wisconsin standard also approved by the Secretary allows up to 89°F. after mixing, at the shoreline and in harbor waters. Some, but not all, of these standards also include various provisions limiting rates of temperature increase and increases over natural temperature.

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The Michigan standard, which has not been approved by the Secretary, establishes no numerical limits, but is a general statement designed to abate or prevent injury of any kind due to temperature to any type of water use or value.

All four States grant approval for the nuclear power plants with the understanding that requirements may be revised if experience proves the need for revision.

Most of the plants propose to draw cooling water from some distance out in the lake where the temperature only infrequently will be above 65°F. Thus the temperature of the cooling water can be increased a reasonable amount without exceeding the standards for the lake water. Most of the plants propose to discharge the cooling water through channels ending at the shoreline; though one (Zion, in Illinois) plans to discharge through a dispersion device about 700 feet from shore. Discharge velocity at the shoreline of two to four feet per second will tend to float the warm water on the lake surface with a minimum of mixing. This will allow maximum cooling from evaporation and radiation, and minimum addition of heat to the lake water, but will permit maximum temperature of the floating heated water mass. Since such discharges generally tend to travel up or down the shoreline rather than out into the lake, the greatest damage to aquatic life along the shore could result from this method.

Large quantities of cooling water are required by nuclear power plants. The Zion plant, for example, will use an annual average of 2,940 cfs, with a maximum of 3,400 cfs in summer. If all plants anticipated by 1980 used cooling water at the same rate as Zion, the cooling water use by then could average 17,500 cfs, with a maximum of 20,000 cfs in summer. If evaporative cooling towers had to be used for all of this water and there were a two percent loss of water by evaporation, the total water evaporated would be 400 cfs in summer. If power production continued to double and evaporative cooling towers were used for all cooling water, the rate of evaporation by the Year 2000 could be 1,600 cfs.

Dry cooling towers are feasible but less efficient and more costly than evaporative cooling towers.

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The alternatives for disposal of cooling water, and their potential advantages and disadvantages appear to be:

1. Use of evaporative cooling towers and other off-lake cooling devices. Least thermal effect on lake water quality and uses. Maximum diversion of lake water by evaporation.

2. High velocity dispersion through submerged devices well out into lake. Minimal immediate thermal effect on water quality and uses; but maximum addition of heat and increase in lake temperature on long-term basis. Minimum evaporation of heated water.

3. Low velocity discharge to surface at shoreline to float water on surface. Maximum potential for damage to aquatic life along the shoreline. More diversion of lake water by evaporation than high velocity dispersion and mixing; but less addition of heat to lake on long-term

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basis.

Unfortunately, the present state of the art does not allow quantitative estimates of the various potential effects of heated waste discharges on a body of water as complex as Lake Michigan.

Much can be learned of effects of heat on lake water by investigations of aquatic life in the vicinity of existing fossil fuel power plants.

Radionuclides are produced in reactors by both fission of nuclear material and by neutron activation of reactor materials, of minerals in the water used as a coolant to produce steam, and of the hydrogen of the water itself. The nuclides thus produced find their way into the waste stream through leaks in various types of equipment and from the laboratory and laundry.

Treatment by detention and decay, sedimentation, filtration, evaporation and demineralization reduces all radionuclides except tritium to very low levels. Tritium is radioactive hydrogen that is incorporated in the water and is not removed by any of the treatment processes. Fortunately, tritium is one of the least hazardous of all radionuclides and has one of the highest maximum allowable limits in drinking water (3×10^{-3} μc/ml). Estimated discharge of all radionuclides, except tritium, from all proposed nuclear power plants total less than one curie per year. Experience at four of six relatively small plants already in operation, however, has shown discharge of radionuclides ranging from 1.3 to 11.1 curies per year. Tritium discharged by the six plants ranged from five to 1,300 curies per year. The radioactive wastes of the six plants, after treatment, were in volumes ranging from 208 to 4,820 gallons per day.

The treated radioactive wastes will be diluted in the large volumes of cooling water for final disposal to the lake. Discharge will be by batches after each batch has been sampled and analyzed. Dilution in the cooling water is estimated to bring the radionuclide concentrations down to 10 to 20 percent of the permissible limits specified in the Atomic Energy Commission's 10CFR20 regulations. The States standards generally require that radionuclide concentrations comply with the Public Health Service Drinking Water Standards. Compliance with the AEC 10CFR20 regulations will ensure compliance with the PHS Drinking Water Standards.

A basis for evaluation of the possible effect on the lake as a whole is that 49,000 curies of radioactivity would have to be present to give a concentration of 10^{-8} uc/ml (10 percent of permissible level), or 490,000 curies for a concentration of 10^{-7} uc/ml. Nearly 1.5 billion curies of tritium would be required to equal the permissible concentration for this radionuclide in the lake. There is no cause for concern for the effects of radioactive wastes on the lake as a whole.

There is a possibility of concentration of radioactivity locally in the aquatic life that serves as the food chain for fish, with a potential hazard to those who eat fish from the lake. Experience with wastes from smaller nuclear power plants discharging to streams in Illinois and Wisconsin and to the lake in Michigan has not revealed such a problem, but it is one that must be evaluated when the larger plants go into operation on the lake.

The policy of AEC and the States that radioactive wastes in the environment must be kept to the lowest practical level requires that radioactive discharges from the nuclear power plants be held to the minimum feasible quantities.

Review of available literature, attendance at national symposia on thermal pollution, and discussions with various consultants in the field have revealed many gaps in knowledge of the effects of thermal wastes on water quality and uses and of preferable means of disposal. There is an urgent need for investigation, especially biological, of the effects on Lake Michigan of heated wastes discharged from existing fossil fuel power plants.

There also is a need for acquisition of data on present water quality and aquatic life in the vicinities of the proposed nuclear power plants to provide a basis for evaluation of effects of the wastes after the plants go into operation. Various power companies, and consultants, and Federal and State agencies presently are making more or less independent investigations. All of these investigations should be coordinated to the maximum extent possible.

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RECOMMENDATIONS

It is recommended that:

1. All power plants, both nuclear and fossil fuel, meet the waste disposal requirements and water quality standards of the States in which they are situated.

2. Design personnel for all future power plants consider or evaluate the possible subsequent addition of off-lake cooling devices, extended cooling water effluent lines with submerged, high velocity discharges, and other methods of controlling effects of thermal wastes on the lake so that such devices can be added if found to be necessary.

3. Radioactive liquid wastes discharges to the lake be kept to the minimum feasible.

4. Individual States ensure that adequate base line data on water quality and aquatic life be obtained at all proposed power plant sites, and that adequate post-operational monitoring be provided, and results be made available to all parties concerned.

5. Coordinated study of the thermal

effects on water quality and aquatic life of one or more fossil fuel plants now discharging cooling water to Lake Michigan, and of various methods of cooling water dispersion be undertaken by FWPCA.

6. FWPCA coordinate a comprehensive study of the effects on water quality and aquatic life of thermal wastes from a large nuclear power plant on Lake Michigan, with attention to various methods of cooling water dispersion.

7. FWPCA coordinate a study of the effects on water quality and uses of radioactive wastes from a large nuclear power plant on Lake Michigan, with especial attention to the concentration of radionuclides in aquatic life.

8. The Atomic Energy Commission be requested to coordinate the development of a plan for the State agencies, the FWPCA, the U. S. Public Health Service and other appropriate agencies, for emergency methods to deal with accidental radioactive releases (gaseous as well as liquid) on Lake Michigan, including an inventory of appropriate laboratory and evaluation resources.

APPENDIX A

RECOMMENDED PLAN OF STUDY in the Vicinities of PROPOSED NUCLEAR POWER PLANTS

The objectives of the recommended study are to:

1. Obtain pre-operation data on water quality and aquatic life in the vicinities of proposed nuclear power plants.

2. With the pre-operation data as a basis, determine and evaluate the effects of thermal and nuclear wastes on water quality and uses after the plants go into operation.

The recommended plan presumes the active cooperation of interested Federal and State agencies and of the appropriate power companies. The Federal Water Pollution Control Administration is considered the proper agency to coordinate the participation of the various agencies.

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An attempt has been made to incorporate all possible details that might be useful in a study. Some revision undoubtedly will be necessary to fit the plan to available facilities, and to adapt it to local circumstances and conditions. The portions of the proposed plan involving thermal effects can be adapted to a study of effects of fossil fuel plants on aquatic life. If studies of thermal effects of fossil fuel power plants should prove that there is no reason for concern over thermal effects of nuclear power plants, the portions of the outline dealing with thermal effects can be eliminated in studies of nuclear plant wastes.

STUDY PLAN

I. Preliminary examination.

   A. Determine existing currents (FWPCA has continuous directional current records that may be used).

   B. Estimate area that will be affected by thermal wastes.

   C. Determine nature of bottom in area expected to be affected.

   D. Select and mark sampling stations by submerged floats with anchors, or some other device, that will ensure subsequent correct location when sampling.

E. Locate and arrange for sampling points at areas of special water use, such as water supply intakes.

II. Bottom Samples.

A. General

1. Types of samples.
    a. Bottom organisms.
    b. Bottom sediments.
2. Station Locations.
    a. At least 10 random stations for each type of bottom (sand, clay, gravel, rock, etc.).
3. Sampling Equipment.
    a. Dredge suitable for type of bottom involved (Petersen, Ponar, etc.).
4. Sampling Frequency.
    a. Once at each station in May and in October of each year.

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B. Bottom Organisms.
  1. Determine kinds and numbers of each kind.
  2. Combine bottom organisms and determine radioactivity.
    a. Gross alpha and beta scan.
    b. Gamma scan.
      (1) Identify individual radioisotopes.
    c. Radium-226*
      (1) One or two samples each sampling time.
    d. Strontium-89 and -90.

C. Bottom Sediments.
  1. Determine radioactivity.
    a. Gross alpha and beta scan.
    b. Gamma scan.
      (1) Identify individual radioisotopes.

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*Not a reactor waste constituent, but a factor is natural background.

c. Radium-226.

  (1) One or two samples each sampling time.

d. Strontium-89 and -90.

e. Total uranium.

  (1) One or two samples each sampling time.

III. Artificial Substrate Biological Samples.

  A. Station Locations (four total).

    1. One at point of cooling water disdischarge.

    2. Two near shore, in opposite directions from point of discharge.

    3. One about one-quarter mile offshore opposite point of discharge.

  B. Sampling Equipment.

    1. Anchored artificial substrate of suitable material floating submerged at uniform depth appropriate to avoid navigation.

  C. Sampling Frequency.

    1. Place substrates in April, July,

October and January (if possible).

2. Remove about one month later (if some other period selected, removals should be at a uniform period).

D. Determinations.

1. Count and identify bottom organisms.

2. Identify and quantitate periphyton.

3. Determine radioactivity of mixed organisms.

a. Gross alpha and beta scan.

b. Gamma scan.

c. Radium-226.

(1) One or two samples at each sampling time.

d. Strontium-89 and -90.

IV. Plankton Samples.

A. Sample Locations (four total).

1. At same locations as artificial substrates.

B. Sampling Frequency.

1. At same times as artificial substrates placed or removed.

C. Determinations.

1. Count and identify plankton, using Sedgwick-Rafter cell.

2. Determine radioactivity.

a. Gross alpha and beta scan.

b. Gamma scan.

(1) Identify individual radioisotopes.

c. Radium-226.

(1) One or two samples each sampling time.

d. Strontium-89 and -90.

V. Fish Studies.

A. Gill net sampling.

1. Station Locations.

a. Two, one-quarter mile each direction from point of cooling water discharge.

b. From five-foot depth near shore, extending 400 feet into lake, perpendicular to shore.

2. Sampling Equipment.
    a. Gang gill nets with following sections:
        (1) 200 feet of 2-1/2" mesh.
        (2) 100 feet of 1-1/2" mesh.
        (3) 100 feet of 1" mesh.
3. Sampling Frequency.
    a. Four times yearly (at times of either placing or removing artificial substrates for biological samples).
    b. Nets in place two days between setting and lifting.
4. Determinations.
    a. Kinds and numbers of each kind of fish.
    b. Size and weight of each.
    c. Age of each.
    d. Radioactivity of fish flesh.
        (1) Gross alpha and beta scan.
        (2) Gamma scan.
            (a) Identify individual radioisotopes.

(3) **Radium-226.**

(4) Strontium-89 and -90.

B. Shoreline observations.

1. Area.

   a. Along shore, in each direction from point of cooling water discharge, as far as warm water extends or is expected to extend (possibly one to four miles, depending on method of discharge of cooling water, whether mixed quickly or floated on surface of lake).

2. Frequency.

   a. Four times yearly (during gill net observations).

3. Observations.

   a. Record kinds and estimated concentrations of fish visible from shore.

   b. Fishing and spawning areas.

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VI. Wildlife Observations.

- A. Area.
  - 1. Visible from shore in each direction from point of discharge as far as warm water extends or is expected to extend.
- B. Frequency.
  - 1. Four times yearly.
  - 2. At times of fish studies.
- C. Observations.
  - 1. Kinds and concentrations of water fowl.
    - a. Locations in regard to warm water.
    - b. Feeding habits.
      - (1) Dead fish.
      - (2) Live fish.
      - (3) Bottom foods.

VII. Shoreline Observations.

- A. Observe shoreline at point of cooling water discharge and in each direction from this point as far as temperature change is anticipated. (Suggest as much as four miles in each direction if cooling water floated on surface, and one mile if cooling water is mixed rapidly by high velocity dispersion.)

B. Frequency of Observations.

1. Four times yearly.
2. Preferably in May, August, November and February (if possible, since these will be convenient times to remove artificial substrates).

C. Observations.

1. Aquatic growths of interest.
    a. Cladophora especially.
        (1) Distance along shoreline this filamentous algae grows.
        (2) Rough approximation of quantity, as "Abundant," "Moderate," or "Sparse."
        (3) Approximate length of filaments or of massed growth.

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VIII. Water.

- A. Types of Studies.
  - 1. Temperature.
  - 2. Radioactivity.
  - 3. Other.
- B. Temperature.
  - 1. Before power plant in operation.
    - a. Continuous records.
      - (1) Point of cooling water intake.
      - (2) Point of cooling water discharge.
        - (a) Presumably representative of ambient temperature of water in area adjacent to power plant.
  - 2. After power plant in operation.
    - a. Continuous records (FWPCA has temperature recorders).
      - (1) Influent cooling water.
      - (2) Effluent cooling water.

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b. Spot determinations (preferably continuous recorders if enough instruments available).

   (1) Grid of stations on one-quarter mile centers, permanently marked, in area extending one mile into lake and four miles up and down shore from point of cooling water discharge.

   (2) Sample once weekly until various patterns of cooling water plume have been established, and once monthly thereafter (unless continuous recorders available).

   (3) Determine temperatures in cooling water plume and boundary water only, on day of sampling.

   (4) Determine temperature at surface, five-and ten-foot

depths at each station in plume, or at such depths as necessary to establish depth of plume.

C. Radioactivity.

1. Before power plant in operation.

a. Sampling points.

- (1) Point of cooling water discharge.
- (2) Point or area of any special water uses.
  - (a) Water supply.
  - (b) Bathing beaches.
  - (c) Other.

b. Sampling Frequency.

- (1) Monthly grab sample at stations.

c. Determinations.

- (1) Gross alpha and beta.
- (2) Gamma scan.
  - (a) Identify individual radioisotopes.

- (3) Radium-226.
    - (a) One or two samples each sampling time.
- (4) Total Uranium.
    - (a) One or two samples each sampling time.
- (5) Tritium.

2. After power plant in operation.
    - a. Sampling points.
        - (1) Influent cooling water.
        - (2) Effluent cooling water.
        - (3) Special water uses.
            - (a) Water supply.
            - (b) Bathing beaches.
            - (c) Other.
    - b. Sampling Frequency.
        - (1) Daily grab samples composited for one week.
            - (a) Ensure that grab samples include representative portions of batch

radioactive waste discharges.

c. Determinations.

  (1) Gross alpha and beta.

  (2) Gamma scan.

    (a) Identify individual radioisotopes.

  (3) Radium-226.

    (a) One or two samples each sampling time.

  (4) Total Uranium.

    (a) One or two samples each sampling time.

  (5) Tritium.

D. Other.

1. Studies for other constituents such as bacteria, boron, algicides, etc., not specified, but to be fitted into pattern of and coordinated with temperature and radioactivity studies.

2. One or two sets of samples should be analyzed for dissolved oxygen to determine

whether increased temperature of cooling water significantly affects dissolved oxygen. Discontinue if no significant effect is found.

APPENDIX B

Temperature Increase in Lake Michigan Due to Thermal Discharges from Electrical Power Facilities

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November 1968

The following approach to predicting the temperature elevation of Lake Michigan due to thermal discharges from electrical power facilities is based on work published by Veltz and Gannon (1). The calculation is intended only to provide a crude estimate of the order of magnitude of the temperature elevation. It assumes instant mixing and thus ignores localized effects. However, the assumption of instant mixing does tend to make the estimate conservative.

Essentially the method considers heat additions and losses from various sources such as convection, radiation, and evaporation. The nomenclature used is as follows:

ΔH = net rate of heat gain or loss (BTU/hr - sq.ft.)

H_e = rate of heat loss by evaporation "

H_c = rate of heat loss by convection "

H_r = rate of heat loss by radiation "

H_s = rate of heat gain by solar radiation "

ϕ = rate of heat addition from electrical power facilities "

L_v = latent heat of vaporization for water (BTU/lb)

V_w = vapor pressure of water (in Hg)

V_a = vapor pressure of water in air "

T_w = water temperature (°F)

T_a = air temperature (°F)

T_1, T_2 = equilibrium water temperatures (°F)

W = wind velocity (mph)

C = a constant varying for different water bodies (for large deep lakes, C = 10)

The various heat rates are calculated from empirical relations presented by Veltz and Gannon (1). They are as follows:

$$H_e = 0.00722\ CL_v(1 + 0.1W)(V_w - V_a) \qquad (1)$$

$$H_c = (0.8 + 0.16W)(T_w - T_a) \qquad (2)$$

$$H_r = 1.0\ (T_w - T_a) \qquad (3)$$

At equilibrium, the net heat gain or loss is zero, and the rate of heat lost is equal to the heat gain. Therefore, for an equilibrium temperature T_1 and no thermal contributions from power facilities,

$$\Delta H = H_{s_1} - H_{e_1} - H_{c_1} - H_{r_1} = 0. \qquad (4)$$

If now, for purposes of comparison, all conditions are kept the same except that an addition term representing the heat added by power facilities is included, a new equilibrium temperature T_2 will be defined by

$$\Delta H = H_{s_2} - H_{e_2} - H_{c_2} - H_{r_2} + \phi = 0.$$

The result of combining the two expressions is,

$$(H_{s_1} - H_{s_2}) + (H_{e_2} - H_{e_1}) + (H_{c_2} - H_{c_1}) + (H_{r_2} - H_{r_1}) - \phi = 0. \qquad (5)$$

The heat gain due to solar radiation depends upon the amount of radiation reaching the water and hence on meteorological conditions. For the purpose of this calculation, it will be considered that the meteorological conditions are, in the two cases, sufficiently identical to result in equal heat gain from the sun. It is assumed, then, that, under identical meteorological conditions,

$$H_{s_1} = H_{s_2}. \qquad (6)$$

This assumption is given support in the note following the conclusion.

The evaporation term is given by Equation 1. To solve for a temperature or a temperature difference, the temperature must be explicit. This is not the case for Equation 1, but a Taylor expansion of the temperature dependent terms can be used. The two terms which are dependent on temperature are the latent heat of vaporization for water and the vapor pressure of water. It follows that,

$$L_v(T) = L_v(T_o) + \left.\frac{dL_v(T)}{dT}\right|_{T = T_o} (T - T_o) + \ldots\ldots$$

and,

$$V_w(T) = V_w(T_o) + \left.\frac{dV_w(T)}{dT}\right|_{T = T_o} (T - T_o) + \ldots\ldots$$

With a small temperature change, the terms of order higher than one in the expansion may be neglected. Further, the following approximation can be used:

$$\left.\frac{dL_v(T)}{dT}\right|_{T = T_o} = \frac{L_v(T) - L_v(T_o)}{T - T_o} = \left.\frac{\Delta L_v}{\Delta T}\right|_{T = T_o}$$

and,

$$\left.\frac{dV_w(T)}{dT}\right|_{T = T_o} = \frac{V_w(T) - V_w(T_o)}{T - T_o} = \left.\frac{\Delta V_w}{\Delta T}\right|_{T = T_o}$$

To obtain values for these approximations, the following data are used (2). Assume a water temperature of 50°F.

Temperature (°F)	V_w(in Hg)	L_v (BTU/lb)
50	0.362	1062.3
51.8	0.387	1061.3
53.6	0.414	1060.4

thus,

$$\left.\frac{\Delta L_v}{\Delta T}\right|_{T = T_o} = -\frac{1.0}{1.8} = -0.556 \quad \left(\frac{\text{BTU}}{\text{lb} - {}^\circ\text{F}}\right)$$

and,

$$\left.\frac{\Delta V_w}{\Delta T}\right|_{T = T_o} = \frac{0.025}{1.8} = 0.0139 \quad \left(\frac{\text{in Hg}}{{}^\circ\text{F}}\right)$$

therefore,

$$L_v(T) = -0.556(T-50) + 1062.3 \quad (\text{BTU/lb})$$

and,

$$V_w(T) = 0.0139(T-50) + 0.362 \ (\text{in Hg})$$

Simplifying,

$$L_v(T) = -0.556T + 1090.1 \quad (\text{BTU/lb})$$

and,

$$V_w(T) = 0.0139T - 0.333 \quad (\text{in Hg})$$

To use Equation 1, it is necessary to know the vapor pressure of the water in air. To arrive at this, it is necessary to assume an air temperature and a humidity. The assumptions used are an air temperature of 60°F and a humidity of 60%. The following relation, taken from Perry's Handbook of Chemical Engineering, page 765, can be used to determine the vapor pressure (2):

$$V_a = \frac{wP}{4360 + w}$$

where,

w = moisture content of air (grains/lb)

P = barometric pressure (in Hg)

Using the psycometric chart (Figure 3) on page 765 of Perry's Handbook, for the conditions assumed, the moisture content is 46 grains/lb. dry air (2). Thus, using the standard atmospheric pressure of 29.92 in Hg,

$$V_a = \frac{(46)(29.92)}{4360 + 46} = 0.312 \text{ in Hg}$$

Substituting the above results into Equation 1 yields after simplification,

$$H_e = (1.0 + 0.1W)(-5.68 \times 10^{-4} T^2 + 1.120T - 50.76) \qquad (7)$$

Substituting Equations 2, 3, 6, and 7 into Equation 5 results in,

$$(1.0+0.1W)(-5.68\times10^{-4}(T_2^2-T_1^2)+1.120(T_2-T_1)\ ) +(1.8+0.16W)(T_2-T_1)-\phi = 0$$

But, for small temperature changes,

$$T_2^2 - T_1^2 = (T_2 - T_1)(T_2 + T_1) - 2T_1(T_2 - T_1)$$

Letting $\Delta T = T_2 - T_1$, it follows that,

$$(1.0 + 0.1W)(-1.136 \times 10^{-3}\, T_1\Delta T + 1.120\Delta T) + (1.8 + 0.16W)\,\Delta T - \phi = 0$$

and,

$$\Delta T = \frac{\phi}{(1.8 + 0.16W) + (1.0 + 0.1W)(-1.136 \times 10^{-3}T_1 + 1.120)}$$

The total heat input into the lake from power facilities is estimated to be 6.88×10^{14} BTU/year. The area of the lake is 2.24×10^4 square miles.

Thus,

$$\phi = \frac{6.88\text{x}10^{14}(\text{BTU/yr})}{365(\text{d/yr})\text{x}24(\text{hr/d})} \times \frac{1}{2.24\text{x}10^{4}(\text{sq.mi.})(5280)^2(\text{sq.ft./sq.mi.})}$$

and,

$$\phi = 0.126 \text{ BTU/hr-sq.ft.}$$

For a water temperature of 50°F and no wind,

$$\Delta T = \frac{0.126}{1.8+1.0(-1.136\text{x}10^{-3}(50)+1.120)}$$

and,

$$\Delta T = 0.044\ ^\circ\text{F}.$$

For a wind velocity of 1 mph,

$$\Delta T = \frac{0.126}{(1.8+0.16) + (1.0+0.1)(-1.136\times10^{-3}(50)+1.120)}$$

and,

$$\Delta T = 0.040\ ^\circ F$$

The following table lists the temperature elevation for various wind velocities (these are at equilibrium).

Wind velocity (mph)	T (°F)
0	0.044
1	0.040
3	0.034
5	0.030
10	0.023

It should be noted that, for a given set of conditions, the temperature elevation is directly proportional to the heat added. Thus, if the heat addition from electrical power facilities were to double from that used in this calculation, the temperature elevation would be twice that shown here. The temperature elevation is inversely proportional to the surface area of the lake. Thus, if only half of the lake were to be considered, the temperature change would be doubled.

It should also be pointed out that, for this particular technique, the result is not very sensitive to changes in values of air temperature, humidity, and barometric pressure. This means that the assumptions used for these values were not critical. The assumptions regarding the small temperature elevation are justified by the results.

In conclusion, the temperature elevation of Lake Michigan resulting from the thermal addition of existing and proposed electrical power facilities is crudely estimated to be 0.05 °F.

Note

The assumption that, under identical meteorological conditions, $H_{s_1} = H_{s_2}$ can be supported by considering the Stephan-Boltzman law of radiation between two bodies (3).

$$R = C(T_1^4 - T_2^4)$$

where,

R = net radiated energy

C = constant

T_1 = absolute temperature of the warmer body

T_2 = absolute temperature of the colder body

Considering that the sun has a surface temperature of about 6000° Kelvin, and the lake temperature is about 300° Kelvin, it is seen that the temperature of the lake has little effect on the net radiated solar energy. Thus, the heat gained from solar radiation is primarily dependent on meteorological conditions.

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MR. STEIN: Thank you, Mr. Kittrell.

Are there any comments or questions?

MR. KLASSEN: I just want to comment that this is quite a comprehensive report. Before I as a Conferee would want to accept this, there would be a few additions that I think ought to go in here.

It seems as though the Committee approached this with the idea that thermal pollution is something detrimental. Maybe it is. But I would like to know whether there are any beneficial effects on the aquatic life.

From one statement you made, you said the heated water, warmer water, would encourage the growth of undesirable biological life. I am no biologist and, therefore, I can't argue with you, but I am just not too sure that this is a conclusion.

MR. KITTRELL: Well, we said it might. We didn't say it would.

MR. KLASSEN: All right, you took my next point.

All the way through here "possibly it could", "it might", this isn't very helpful to those of us who have got to say yes or no to a concern.

Another point in here, instead of throwing away all this heat by suggesting other methods of wasting it and dispersing it, I think that this Committee could also address itself into how are we going to use this tremendous amount of energy that is in here. It might sound wild, but possibly it could be piped to a nearby town and heat all the houses, for example.

I don't know. There might be other things.

I think we have approached this, and this is, I think, in the category of detergents and a number of other things, with the idea--and I don't say detergents are good--but with the idea that thermal pollution is something bad. Maybe it is. We don't know. But I think that we ought to evaluate all aspects of it.

We have some reason to believe--and we have had a lot of experience with this on the Illinois River, with the largest nuclear power plant in the world, unless the Russians have a bigger one--there is some evidence that the biological life that is involved in the regeneration in a stream and the natural purification is moved up instead of downstream, it has moved up closer to the outlet, a possible advantage of thermal wastes.

I would just like to see this Committee address itself to the other side and see if there isn't something good that we can find in this large amount of heated water that we are trying to find ways of throwing away.

MR. KITTRELL: I might add that it has been thought that some of the heated water might be piped in there for swimming areas, made useful for swimming purposes.

MR. KLASSEN: This is right. Since you have raised this question, the discharge from the Zion plant will be several hundred feet north of one of our State parks, and the former Director of Conservation said it could be an advantage in that it would permit swimming much later in the year than it does now. Last year there were five days when the temperature of the lake, even in the summer, was suitable. This might be another advantage.

The other thing, and this is another comment, I would want to restudy some of your recommendations here. And believe me, Mr. Chairman, I am not getting into the question of another jurisdiction. But I question whether we want the Atomic Energy Commission to coordinate the development of a plan of State agencies in all of this. I think this is kind of whistling in the dark.

We already have a plan in Illinois, we work very closely with AEC, but I think there is too much Federal agency coordinating some of these things when I am not too sure that this is what they wanted to do or it should be done.

MR. STEIN: Any other comment?

Mr. Purdy.

MR. PURDY: Kit, in your calculations you indicate a warming of five-hundredths of a degree Fahrenheit per year. It is my understanding that in the southern basin there is complete cooling in the wintertime. That is from top to bottom the southern basin cools to roughly 2.3 degrees Centigrade from top to bottom, which would indicate that any residual heat from the summer period would be lost during the winter period in this southern basin.

Would your calculations indicate that there would be enough heat added so that you wouldn't lose this residual heat in the wintertime in the southern basin?

MR. KITTRELL: Well, this was my first opinion. I am no expert on thermodynamics, but several of the more recent college graduates who were involved sat on me real hard on that and said there will be some residual heat carried over and it will be accumulated until it reaches a new equilibrium. I have to accept their word on this. I felt exactly the way you do at first.

MR. PURDY: I would like to lean on your long years of experience, Mr. Kittrell.

MR. KITTRELL: How is that?

MR. PURDY: I say I would like to lean on your long years of experience in this field.

MR. KITTRELL: Well, as I say, I had no thermodynamics in college, so I bowed to the opinions of others who have had this sort of education much more recently.

MR. PURDY: I think this is a question that needs exploring before this conclusion is made a part of the record.

Not as a question but as a comment, for those of us that are faced with setting restrictions, I think your report places this clearly in focus when you state that, "Unfortunately, the present state of the art does not allow quantitative estimates of the various potential effects of heated waste discharges on a body of water as complex as Lake Michigan."

That is all I have, Mr. Chairman.

MR. STEIN: Thanks.

Are there any other comments or questions?

To take up what Mr. Klassen said, Mr. Kittrell, when you talked about the increase of two degrees by 2023, two degrees Fahrenheit, you say, "This increase would nullify a 2.0°F decrease in average annual temperature of the lake that has occurred, apparently from natural causes, in the past 100 years."

The question again that Mr. Klassen raises is, is this good or is this bad? Supposing the computations are correct. I do know that we have one situation that has happened in a much shorter range of time. The temperatures around Maine in the ocean have dropped seven degrees over a much shorter period of time and because of that the lobsters are not growing as fast, as you can tell by checking the price of a lobster in a restaurant these days. One of the projects that came in--I don't believe it was approved--was to try to use the heated water from one of these thermal nuclear plants to raise the temperature of the water so it would be more nearly the temperature where the lobsters would produce flesh more rapidly.

Again, we get to the question of whether, per se, in any or all environments, a lower temperature is the desired condition or whether we should have it. I don't know. I just raise this. I know when you have a balanced environment, any change up or down is going to shift that one way or the other.

MR. KITTRELL: I guess it was Clarence who said he is no biologist. Mackenthun was very concerned that any significant increase in temperature might cause an outbreak of Cladophora. This is one of the things that Jimmy Vaughn mentioned this morning--that he had trouble with the Cladophora at the water intake already.

MR. STEIN: Now, if that is the case, again, I want to put this as delicately as I can. What I was afraid of and the difficulty with one of these committees you set up is that the traditional or almost cliche result that they come up with, after spending six months looking at and studying the problem, their main conclusion is: "What we need is a further study."

And I think in large measure that is what we have here.

You say, "There is an urgent need for investigation, especially biological, of the effects on Lake Michigan."

"There is also a need for acquisition of data on present water quality and aquatic life," and so forth.

Then several of the recommendations you have, "FWPCA coordinate"--I don't know who they are supposed to coordinate--"a comprehensive study of the effects on water quality and aquatic life."

"FWPCA coordinate a study of the effects on water quality and **uses** of radioactive wastes from a large nuclear power plant on Lake Michigan, with especial attention to the concentration of radionuclides in aquatic life." Which may be the same which may be a little different on the **specifics**.

But what the Committee has come up with after all this time is a recommendation for further studies.

MR. KITTRELL: That is quite right.

MR. STEIN: Well, again, you see, if Mackenthun, who is about as good an aquatic biologist as I know of, thinks that a rise in water temperature or effects from a thermonuclear plant, or any other powerplant, is going to create a condition which might cause the growth of Cladophora, which is an algae, as some of you may know, in the lake, and if this is the case and if this is put out, I think this is something that the Conferees can get their teeth into.

But again the notion is--and I say this on the basis of experience, and, Kit, you have been around at least as long as I have--that if we coordinate a comprehensive study or coordinate a study on the effects of water quality as recommended, there is no assurance that the results of this won't be a recommendation to come up with another study. This can go on forever.

MR. KITTRELL: I don't have anything to do with that, Murray. I will be retired by then.

(Laughter.)

MR. STEIN: I understand that. But let me ask you one more specific point on this.

Point 3. "Radioactive liquid wastes discharges to the lake be kept to the minimum feasible."

Did you ever consider not putting any in at all?

MR. KITTRELL: I tried to get the Committee to make such a recommendation, but I was unable to.

MR. STEIN: All right. I thought you might have. There is no collusion on this.

This is always a question. The point is if salt is going to get in the lake, as Jim Vaughn pointed out, it is not going to get out. If radionuclides get into the lake, however small they are, given their long-term half life, some over thousands of years, we are going to be stuck with them a very long time too. What is the notion of putting any in?

MR. KITTRELL: I don't get your question.

MR. STEIN: Well, the problem that I have with this is we have had a lot of testimony before this Conference and other conferences, before Congressional hearings, and in the newspapers about putting dredged material in the lake and dredged material that is presumably inert and benign, and you might have the point we are not cleaning up the lake just to make it a dump and put it in the lake.

Now, if we have this kind of situation with inert dredged material that the Corps is taking out, how do we come up with a notion of putting any radioactive discharges into the lake at all? If we are keeping out some rock or someone is making a move to keep out some rock that the Corps is chipping away from the outside of the harbor and dumping it in the lake where there is no demonstratable harm, how can we come up with a recommendation that there should be radioactive wastes discharged to the lake, however small?

I am just asking you that.

MR. KITTRELL: Well, as I say, I favored such a recommendation.

MR. STEIN: All right.

MR. KITTRELL: You will have to talk to the rest of the Committee.

MR. STEIN: Are there any other comments or questions?

If not, thank you very much.

We may be into trouble with this room, and I am debating two things. We don't have too many more points and we are supposed to be out of here by

5 o'clock, but maybe we can stretch that. I think the better part of valor, though, is to take a very short recess. I am asking everyone to take a 10-minute recess so we can get back here and not overdo our welcome and have a battle with them. If we just take 10 minutes and come back, I think we will be able to be finished just a little after 5.

We will stand recessed for 10 minutes.

(RECESS)

MR. STEIN: Let's reconvene.

The next problem we will take up is the pesticide evaluation, the report of the Committee.

Mr. Poston.

MR. POSTON: Dr. Mount, Director of our National Water Quality Laboratory in Duluth, will make this presentation.

STATEMENT OF DONALD I. MOUNT, Ph.D., CHAIRMAN, LAKE MICHIGAN ENFORCEMENT CONFERENCE PESTICIDES COMMITTEE

DR. MOUNT: Mr. Chairman, and Conferees, I have one disadvantage that Mr. Kittrell didn't have and that is that I don't retire in a few years. (Laughter.)

I have prepared a summary of the Pesticides Committee report, which is some 44 pages in length.

MR. STEIN: Without objection, that report will be entered into the record as if read.

DR. MOUNT: And I will also try to delete some parts of the summary, even, for the sake of time.

The Pesticides Committee created by the Four-State Conference on pollution of Lake Michigan was composed of representatives from each of the four States in the drainage basin, one FWPCA representative who also served as Chairman, one representative from the Bureau of Sports Fisheries and Wildlife and one from the Bureau of Commercial Fisheries. Four regularly scheduled meetings, three of them two days in length, were held and substantial work was done by the individual members between meetings in order to formulate the report we have submitted. Although the charge of this Committee was to examine the question of pesticide pollution in Lake Michigan, the Committee limited its report to insecticides since it could find no evidence that pesticides other than insecticides were of significant importance in the lake. We wish to emphasize that this statement is based on extremely limited information that was available regarding the use of pesticides in the Lake Michigan drainage basin. The members were impressed early in their work by the near total lack of information as to what insecticides are being used and in what quantities. We believe that the collection of this information is of utmost importance if we are to evaluate the size and magnitude of the pesticide problem.

Before formulating any recommendations, the Committee identified the extant problems that could be recognized at the present time. These problems are: (a) the presence of insecticides, especially DDT and dieldrin, in lake water; (b) potential involvement of DDT in coho salmon reproduction; (c) effects of insecticides on gull reproduction; (d) levels of dieldrin in fish flesh approaching the limit recommended by the Food and Drug Administration; and (e) possible involvement of DDT in the failure of mink to reproduce when fed fish from Lake Michigan.

The following letter was written by the Committee to the United States Food and Drug Administration to seek advice regarding possible impact of pesticides in Lake Michigan on human health.

I will not read that letter, but in essence it asks advice from the Food and Drug Administration as to whether there are any established tolerances on fish used for human consumption from Lake Michigan. If not, are there any plans to establish tolerances and for any additional advice that they might have regarding the impact on human health.

The answer, which is on page 4, I will not read either for the sake of time, but in essence it says that there are at present no tolerance levels and that there have been no applications to establish tolerance levels, but that there are provisions under certain sections to establish them should they be deemed necessary.

They further state that while there are not tolerance levels, there are levels which are recognized as being sufficient to warrant legal action and these are given as 0.3 parts per million of aldrin, dieldrin, endrin, heptachlor or heptachlor epoxide present in the edible portion of fish.

The Committee was especially interested in the comments of the Food and Drug Administration, since by data available to the Committee that had previously been collected we realized that the levels were approaching those that are commonly accepted as being in doubt.

Each of the State representatives attempted to gain some reasonable concept of the quantity and type insecticides used in the Lake Michigan drainage. This information obtained is not very reliable, but we believe it is the best that can be obtained at this time. This information, of course, is in the full report. The principal insecticides of concern appear to be DDT, dieldrin, including aldrin which is converted to dieldrin, chlordane and toxephene. It is important to emphasize that apparently less than half of the insecticides used in the United States are used for agricultural purposes and one must not ignore industrial and domestic use of insecticides. It is further important to note that the treatment of Dutch Elm disease with DDT undoubtedly accounts for a very large contribution of DDT to Lake Michigan. It is common for as much DDT to be applied to one elm tree as would normally be used on one acre of cropland; and much of the area surrounding the elm trees may be paved, and that portion of the insecticide that falls to the ground can be more readily washed into the lake than when applied to cropland.

The Committee also attempted to determine programs already in existence regarding the measurement of insecticides in Lake Michigan. We found that the Bureau of Commercial Fisheries, especially the Ann Arbor Laboratory, the Ontario Water Resources Commission, the U. S. Department of Agriculture (the National Pesticides Monitoring Program), the Wisconsin Department of Natural Resources, and Michigan State University all have active programs under way which include some measurements of pesticides in Lake Michigan or the Lake Michigan biota.

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In selecting the monitoring program for the lake, the Committee attempted to stay within practical limits of time, money, and manpower and adopted a four-point approach. These four points involved the measurement of changes in insecticide levels in (1) major tributaries (2) minor tributaries (3) Lake Michigan water and (4) commercial and sport fishes of Lake Michigan. Because insecticides of concern in this report are toxic at concentrations several orders of magnitude lower than for more common pollutants, the Committee has recommended in Table 2 the detection limits at which pesticides should be measured in various types of samples. We do not have the information at this time to say that .001 ug/1 of DDT--which, by the way, would be one part per trillion--in lake water is biologically significant, but it is important to measure this level in order to establish the trend of pesticide contamination in Lake Michigan. For purposes of a survey program, concentrations reported as being less than something are of no value in establishing the trend of the lake.

The Committee has further recommended a

continuous sampling program for three-day periods, twelve times each year, on each of the major tributaries to Lake Michigan. We recognize that this may complicate the sampling program to some extent but we believe that selecting grab samples from such tributaries would be next to useless insofar as pesticide monitoring is concerned. It is generally accepted that pesticides are not uniformly distributed in the water at any point-in-time nor during different stages of stream flow. One can see, therefore, how ridiculous it would be to take a grab sample from each tributary on some scheduled basis and think that he had properly sampled the contribution of that stream to the lake.

The smaller tributaries recommended for monitoring are listed in Table 4; because minor tributaries are numerous and the sampling problems difficult, the Committee is recommending the use of freshwater clams to monitor pesticides in these streams. The clam sampling method is not an innovation of this Committee, but has been used by others in estuarian situations and has also been used by Michigan State University to detect pesticide contamination in lake tributaries. Clams have the distinct advantage in that they represent stream conditions for the previous two to three weeks before the sample is taken and therefore the problems of irregular discharge of pesticides are reduced.

The lake sampling program is recommended to establish the general trend of water concentrations in Lake Michigan for purposes of the future.

The fish sampling program as recommended and outlined in Table 5 forms the real basis of the monitoring program. All of the problems identified in the Committee's search for existing problems were found to be problems involving biological magnification of the pesticides in food chains or human food. Furthermore, there is not enough information at this time to understand or even estimate the importance of a given concentration of an insecticide such as DDT in the water or in the bottom sediments. There appeared to be absolutely no basis to say that a certain water concentration was too high or too low unless, of course, it resulted in direct toxicity. For these reasons, the Committee decided to use the concentrations of insecticides in the fish tissues as being the best sample for monitoring the contamination of pesticides in the lake. In the future, should research efforts establish the meaning of various water concentrations these, then, could become the basis for the monitoring program.

The use of limiting concentrations in the tissues of the fish, as recommended by the Committee, was selected because these levels are practically achievable. They are similar to existing concentrations in some of the other Great Lakes and are safe because no pesticide problems are evident in those lakes where these recommended concentrations are not exceeded.

We recognize that "standards of acceptability" based on concentrations in animals, rather than in water, may be somewhat new to those concerned with pollution control. However, we believe that there is really little difference between basing standards on tissue concentrations or on water concentrations.

Suggestions are provided in the body of the report as to laboratories or agencies which might perform various analyses. The Committee also felt that, because the measurement of insecticides at the concentrations of concern is very difficult and especially positive identification of pesticides by techniques such as infrared spectroscopy, a section in the report should be included concerning quality control. We are not implying that quality control is not a necessary part of any chemical measurement program, but it is of extreme importance in this particular case because very low limits of detection are required. We also underline again the importance of positive identification of the pesticides in at least some of the samples. Gas chromatography is not a positive identification but rather some more sophisticated, but well-established, procedure such as infrared spectroscopy is required.

The research needs as outlined in the report are also important if the monitoring program is to be successful. There are many questions which must be answered before the data provided by the recommended monitoring program can be properly interpreted and applied to the practical situation. The research needs should receive attention as well as the monitoring program.

The following five recommendations contain the essence of the Committee's opinion regarding monitoring and control of pesticides in Lake Michigan.

Recommendation No. 1. The concentration of DDT in the fish should not exceed 1.0 μg/g; DDD should not exceed 0.5 μg/g; dieldrin should not exceed 0.1 μg/g and all other chlorinated hydrocarbon insecticides, singly or combined, should not exceed 0.1 μg/g. Limits apply to both muscle and whole body and are expressed on the basis of wet weight of tissue.

Recommendation No. 2. Each State should establish a regulatory authority to control and record type, quantity and place of insecticide use.

Recommendation No. 3. A Lake Michigan Interstate Pesticides Committee should be created by the Conferees to attain uniformity among the States in pesticide use controls and establish uniform pesticide concentration limits in fish, water and other aspects of the Lake Michigan ecosystem.

Recommendation No. 4. The research needs listed in this report should receive priority equal to that given to the monitoring program.

Recommendation No. 5. The monitoring program presented in this report, and modified as needed, should be implemented at the earliest possible date and continue as long as the insecticide hazard exists.

(The following are the documents submitted by Dr. Mount:)

SUMMARY OF THE PESTICIDES COMMITTEE REPORT

The Pesticides Committee created by the Four-State Enforcement Conference on pollution of Lake Michigan was composed of representatives from each of the four States in the drainage basin, one FWPCA representative who also served as Chairman, one representative from the Bureau of Sports Fisheries and Wildlife and one from the Bureau of Commercial Fisheries. Four regularly scheduled meetings were held and substantial work was done by the individual members between meetings in order to formulate the report we have submitted. Although the charge of this Committee was to examine the question of pesticide pollution in Lake Michigan, the Committee limited its report to insecticides since it could find no evidence that pesticides other than insecticides were of significant importance in the lake.

We wish to emphasize that this statement is based on extremely limited information that was available regarding the use of pesticides in the Lake Michigan drainage basin. The members were impressed early in their work by the near total lack of information as to what insecticides are being used and in what quantities. We believe that the collection of this information is of utmost importance if we are to evaluate the size and magnitude of the pesticide problem.

Before formulating any recommendations, the Committee identified the extant problems that could be recognized at the present time. These problems are: (a) the presence of insecticides, especially DDT and dieldrin, in lake water; (b) potential involvement of DDT in coho salmon reproduction; (c) effects of insecticides on gull reproduction; (d) levels of dieldrin in fish flesh approaching the limit recommended by the Food and Drug Administration; and (e) possible involvement of DDT in the failure of mink to reproduce when fed fish from Lake Michigan.

The following letter was written by the Committee to the United States Food and Drug Administration to seek advice regarding possible impact of pesticides in Lake Michigan on human health.

May 23, 1968

"Food and Drug Administration
"**Washington,**D. C. 20204

"Gentlemen:

"As a result of the recommendations of the Lake Michigan Enforcement Conference a committee has been established to make recommendations to the Conferees regarding a monitoring and control program for pesticides in Lake Michigan. The committee met on May 17 and requested me to seek your agency's advice concerning specific questions. It was the feeling of the committee that there is no evidence for an adverse effect on human health resulting from pesticide contamination in Lake Michigan. However, we realize that we are not in a position to make a decision on this matter and we request the opinion of the Food and Drug Administration in regard to this matter. We would also appreciate your recommendations regarding permissible levels of the important chlorinated hydrocarbon pesticides that are acceptable as residues in fish used for human consumption. Finally, is there legislation in progress now or expected which will establish residue levels in fish products used for human consumption?

"Any other suggestions that the Food and Drug Administration may have regarding either monitoring or control will be received with interest and carefully considered in formulating our committee recommendations.

"Yours truly,

"Donald I. Mount, Ph.D.

"Chairman, Pesticides Committee

"Lake Michigan Enforcement Conference"

The following reply was received from the Food and Drug Administration in response to our inquiry:

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

FOOD AND DRUG ADMINISTRATION

WASHINGTON, D. C. 20204

June 4, 1968

"Dr. Donald I. Mount
Chairman, Pesticides Committee
Lake Michigan Enforcement Conference
Federal Water Pollution Control Administration
U. S. Department of Interior
6201 Congdon Boulevard
Duluth, Minnesota 55804

"Dear Dr. Mount:

"Your letter of May 23 requests information on pesticide residue problems associated with Lake Michigan. We are not in a position to comment on the effects of pesticide contamination of Lake Michigan on human health. There have been instances where the pesticide residue content of fish caught by commercial fishermen in Lake Michigan have been substantial and consideration was given to appropriate legal action. Tolerances for pesticide residues as such, or as food additives, in fish could be established under Section 408 or 409 of the Food, Drug and Cosmetic Act. No petitions for tolerances in fish have been submitted, nor do we have plans to establish tolerances on the initiative of the Commissioner.

"After giving due consideration to analytical problems in sampling, sensitivity and reliability attainable in routine analyses, as well as current knowledge on the toxicology of specific residues, we concluded that legal action is warranted when 0.3 ppm aldrin, dieldrin, endrin, heptachlor or heptachlor epoxide, is present in the edible portion of fish.

This guideline will be reevaluated and changed as additional information becomes available and is not to be construed as a tolerance.

"The above figures are applicable only where there is no history of purposeful use of the pesticide which would result in residues in fish. Furthermore, we would not consider these levels acceptable if a significant proportion of fish marketed contained this concentration of residue.

"In addition to the problem of residues in fish for human consumption, attention should be given to the use of fishery products in animal feeds which might result in residues in meat, milk and eggs.

"We are referring your letter and a copy of our reply to the Federal Committee on Pest Control for their information. You may wish to seek suggestions from that Committee, if you have not already done so.

"If we can be of further assistance or provide additional information on specific questions, we will be glad to do so."

"Sincerely yours,

"R. E. Duggan
"Deputy Associate Commissioner
for Compliance."

D. I. Mount

Each of the State representatives attempted to gain some reasonable concept of the quantity and type insecticides used in the Lake Michigan drainage. This information obtained is not very reliable, but we believe it is the best that can be obtained at this time. The principle insecticides of concern appear to be DDT, dieldrin (and aldrin), chlordane and toxephene. It is important to emphasize that apparently less than half of the insecticides used in the United States are used for agricultural purposes and one must not ignore industrial and domestic use of insecticides. It is further important to note that the treatment of Dutch Elm disease with DDT undoubtedly accounts for a very large contribution of DDT to Lake Michigan. It is common for as much DDT to be applied to one elm tree as would normally be used on one acre of cropland; and much of the area surrounding the elm trees may be paved, and that portion of the insecticide that falls to the ground can be more readily washed into the lake than when applied to cropland.

The Committee also attempted to determine programs already in existence regarding the measurement of insecticides in Lake Michigan. We found that the

Bureau of Commercial Fisheries, especially the Ann Arbor Laboratory, the Ontario Water Resources Commission, the U. S. Department of Agriculture (the National Pesticides Monitoring Program), the Wisconsin Department of Natural Resources, and Michigan State University all have active programs underway which include some measurements of pesticides in Lake Michigan or the Lake Michigan biota.

In selecting the monitoring program for the lake, the Committee attempted to stay within practical limits of time, money and manpower and adopted a four-point approach. These four points involved the measurement of changes in insecticide levels in (1) major tributaries (2) minor tributaries (3) Lake Michigan water and (4) commercial and sport fishes of Lake Michigan. Because insecticides of concern in this report are toxic at concentrations several orders of magnitude lower than for more common pollutants, the Committee has recommended in Table 2 the detection limits at which pesticides should be measured in various types of samples. We do not have the information at this time to say that .001 µg/l of DDT in lake water is biologically significant, but it is important to measure this level in order to establish the trend of pesticide contamination in Lake Michigan. For purposes of a survey program, concentrations reported as being less than something are of no value in establishing the history of the lake.

The Committee has further recommended a continuous sampling program for three-day periods, twelve times each year, on each of the major tributaries to Lake Michigan. We recognize that this may complicate the sampling program to some extent but we believe that selecting grab samples from such tributaries would be next to useless insofar as pesticide monitoring is concerned. It is generally accepted that pesticides are not uniformly distributed in the water at any point-in-time nor during different stages of stream flow. One can see, therefore, how ridiculous it would be to take a grab sample from each tributary on some scheduled basis and think that he had properly sampled the contribution of that stream to the lake.

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D. I. Mount

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The lake sampling program is recommended to establish the general trend of water concentrations in Lake Michigan as a "trend indicator."

The fish sampling program as recommended and outlined in Table 5 forms the real basis of the monitoring program. All of the problems identified in the Committee's search for existing problems were found to be problems involving biological magnification of the pesticides in food chains or human food. Furthermore, there is not enough information at this time to understand or even estimate the importance of a given concentration of an insecticide such as DDT in the water or in the bottom sediments. There appeared to be absolutely no basis to say that a certain water concentration was too high or too low unless, of course, it resulted in direct toxicity. For these reasons, the Committee decided to use the concentrations of insecticides in the fish tissues as being the best sample for monitoring the contamination of pesticides in the lake. In the future, should research efforts establish the meaning of various water concentrations these, then, could become the basis for the monitoring program.

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Recommendation No. 5. The monitoring program presented in this report, and modified as needed, should be implemented at the earliest possible date and continue as long as the insecticide hazard exists.

Donald I. Mount, Chairman, Pesticides Committee of the Lake Michigan Enf. Conference, 2/14/69.

REPORT ON INSECTICIDES IN LAKE MICHIGAN

Prepared by Pesticides Committee
of
The Lake Michigan Enforcement Conference
November 1968

INTRODUCTION

One of the sixteen conclusions reached by Conferees of The Four State Enforcement Conference on pollution of Lake Michigan (January-March 1968) is:

> "Pesticides are found in Lake Michigan and its tributary streams resulting from the application of these materials. The ever-increasing use of these materials threatens water uses for recreation, fish and wildlife, and water supplies."

The Conferees took positive action toward review and study of the pesticide problem in Lake Michigan in their Recommendation No. 15:

> "A technical committee on pesticides will be established to be chaired by a member of the Federal Water Pollution Control Administration with representatives from each State. The committee shall evaluate the pesticide problem and recommend to the Conferees a program of monitoring and control. The first report will be submitted in six months to the Conferees. The States shall seek legislation to license commercial applicators."

Accordingly, the Pesticide Committee members were appointed, and held meetings in Chicago, Illinois, on May 17, June 11-12, and July 9-10, 1968, and in Duluth, Minnesota, on September 19-20, 1968. The Committee consists of:

Dr. Donald I. Mount, Federal Water Pollution Control Administration, Chairman;

Mr. Benn J. Leland, Illinois Sanitary Water Board;

Mr. Stephan Kin, Indiana Water and Waste Laboratory;

Mr. John Favinger, Indiana Natural Resources Department;

Mr. Carlos Fetterolf, Michigan Water Resources Commission;

Mr. Lloyd Lueschow, Wisconsin Department of Natural Resources;

Mr. John Carr, Bureau of Commercial Fisheries;

Dr. Oliver B. Cope, Bureau of Sport Fisheries and Wildlife.

The following report of the technical committee on pesticides contains recommendations based on information obtained by the committee from published material, testimony of experts, unpublished data from studies not yet completed, and from the background and experience of the committee members. Despite this wide range of sources, the information was scanty on most aspects of pesticides in the Lake Michigan watershed, and totally lacking in several critical areas. These factors had a pronounced effect on the nature and scope of the committee's recommendations.

Despite considerably effort by the committee, information necessary to determine the quantity and kinds of pesticides in Lake Michigan was not obtainable, and apparently such information would require large expenditures of time and money. The committee recognized a pressing need for a system to obtain such information. The only significant information available was the levels of DDT and dieldrin (both insecticides) present in Lake Michigan fish.

This report includes only insecticides since there is no information to suggest that any significant amount of pesticide, other than insecticides, has been detected in Lake Michigan or its aquatic organisms.

Thus, the word insecticide is used henceforth.

PROBLEMS RESULTING FROM INSECTICIDE ACCUMULATIONS IN LAKE MICHIGAN

Several indications of insecticide hazards in Lake Michigan have been reported, some of them based on insecticide measurements in the basin and some based on situations in other parts of the country and recognized as probable eventualities in Lake Michigan. The more important ones follow.

Pesticides in Lake Michigan Water

Water samples from Lake Michigan contain insecticides. Samples collected in July 1968 at points five miles west of Ludington, Michigan, and twenty-five miles west of Saugatuck, Michigan, contained chlorinated hydrocarbons. The collections were extracted, and aliquots of the extract were consigned to the Bureau of Commercial Fisheries Laboratory at Ann Arbor, Michigan; Wisconsin Department of Agriculture Laboratory at Madison, Wisconsin; and the Fish-Pesticide Research Laboratory, Columbia, Missouri. The analytical results from these three laboratories were in close agreement, showing the

Saugatuck sample to contain approximately .002 µg/l of DDT, less than .001 µg/l of DDD (TDE), a trace of DDE, and approximately .001 µg/l of dieldrin. The sample from Ludington contained slightly greater quantities of DDT and dieldrin and about the same quantities of DDD and DDE. (Note that .001 µg/l, one part per trillion, of DDT = 167,000,000,000 molecules per liter.) These samples should be representative of Lake Michigan's open water areas, and the amounts of insecticides indicative of widespread distribution throughout the greater portion of the lake. Insecticides are also found in tributary streams which are likely the principal source supplying Lake Michigan.

Hazards to Fish Reproduction

The Michigan Conservation Department has found DDT to be the most probable cause of death of nearly one million coho salmon (Oncorhynchus kisutch) fry hatched from Lake Michigan brood stock. New York studies have established that insecticide accumulations in lake trout (Salvelinus namaycush) brood stock result in reproductive failure. In light of the New York studies and the current residue of DDT and dieldrin in

Lake Michigan fish, it is likely that natural reproduction of lake trout and coho salmon in Lake Michigan is in jeopardy. Other fish species in Lake Michigan probably face similar reproductive hazards although there is evidence only for these two species. Other important commercial and sport fishery species known to have significant insecticide residues include chubs (Leucichthys spp.), alewives (Pomolobus pseudo-harengus), yellow perch, (Perca flavescens), and smelt (Osmerus mordax). All are important in the bionomics of the lake.

Hazards to Bird Reproduction

Wisconsin workers have suggested an insecticide-induced reproductive hazard to gulls in the Green Bay area. This does not imply that the gull population in the Great Lakes area is declining, but suggests a possibility of failures in desirable bird populations. Indeed, the diminishing population trends of raptorial birds, such as eagles, osprey and peregrine falcons in the Lake Michigan drainage basin have been attributed to widespread use of DDT and other insecticides.

Hazards to Human Health

The United States Food and Drug

Administration has established no tolerance level of insecticides in fish utilized for human consumption. The presence of residues in fish flesh has been established by Wisconsin, Michigan, and Federal investigators. The Bureau of Commercial Fisheries has analyzed approximately 30 species of Great Lakes fish in the last three years and has observed insecticides in all species collected from Lake Michigan. The concentration of DDT in chubs from Lake Michigan has averaged 7.5 μg/g plus analogs. Other species have lower but significant quantities of DDT; dieldrin was found in all fish analyzed. The concentration of residue in Lake Michigan fish is usually two to five times higher than in other Great Lakes fish and is substnatially higher in fish from smaller Wisconsin lakes.

Although the presence of residues in Lake Michigan fish has been established, the effects of these residues on human health have not been evaluated. The letter of June 4, 1968, (attached) from R. E. Duggan, Food and Drug Administration, states that the FDA has "no petitions for tolerance in fish" and has no "plans to establish tolerances on the initiative of the

Commissioner." They further state, 'We are not in a position to comment on the effects of pesticide contamination of Lake Michigan on human health," and after considering analytical and technological problems, "...we concluded that legal action is warranted when 0.3 ppm aldrin, dieldrin, endrin, heptachlor or heptachlor epoxide, is present in the edible portions of fish." The Ann Arbor Laboratory (Bureau of Commercial Fisheries) has found some fish with 0.3 ppm dieldrin total body concentrations.

Reproductive Failure of Mink Fed on Lake Michigan Fish

The Reserach Advisory Committee of the Mink Ranchers Association has suggested that mink fed on Lake Michigan fish having a high DDT level have failed to reproduce. The Association has initiated reserach contracts to determine if there is a correlation between pesticide levels in the mink food and the observed reproductive failures.

Relation of Insecticides to Other Pollutants

Evidence of numerous pollutants in Lake Michigan is well documented. Wastes from municipalities, industries, agriculture, and watercraft have contributed to eutrophication, bacterial contamination, excessive algae populations, local oxygen depletions, heated water, and other nuisances. The effects of this complex pollution may be magnified by insecticide pollution either directly or indirectly. Insecticides may not be toxic in the observed concentrations themselves, but as part of a complex of stresses placed on organisms, they may be much more damaging.

The Committee views the quantities of insecticides in Lake Michigan as an immediate problem affecting aquatic life but not human health. It is essential that public officials, industry, and the community recognize this problem and take the necessary action to alleviate hazards caused by insecticide contamination. The higher concentration of insecticides in Lake Michigan fishes, as compared to fishes of the other Great Lakes, suggests that with proper control, lower concentrations can be achieved in Lake Michigan.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
FOOD AND DRUG ADMINISTRATION
WASHINGTON, D. C. 20204

June 4, 1968

Dr. Donald I. Mount
Chairman, Pesticides Committee
Lake Michigan Enforcement Conference
Federal Water Pollution Control Administration
U. S. Department of Interior
6201 Congdon Boulevard
Duluth, Minnesota 55084

Dear Dr. Mount:

Your letter of May 23 requests information on pesticide residue problems associated with Lake Michigan. We are not in a position to comment on the effects of pesticide contamination of Lake Michigan on human health. There have been instances where the pesticide residue content of fish caught by commercial fishermen in Lake Michigan have been substantial and consideration was given to appropriate legal action. Tolerances for pesticide residues as such, or as food additives, in fish could be established under Section 408 or 409 of the Food, Drug and Cosmetic Act. No petitions for tolerances in fish have been submitted, nor do we have plans to establish tolerances on the initiative of the Commissioner.

After giving due consideration to analytical problems in sampling, sensitivity and reliability attainable in routine analyses, as well as current knowledge on the toxicology of specific residues, we concluded that legal action is warranted when 0.3 ppm aldrin, dieldrin, endrin, heptachlor or heptachlor epoxide, is present in the edible portion of fish. This guideline will be reevaluated and changed as additional information becomes available and is not to be construed as a tolerance.

The above figures are applicable only where there is no history of purposeful use of the pesticide which would result in residues in fish. Furthermore, we would not consider these levels acceptable if a significant proportion of fish marketed contained this concentration of residue.

In addition to the problem of residues in fish for human consumption, attention should be given to the use of fishery products in animal feeds which might result in residues in meat, milk and eggs.

We are referring your letter and a copy of our reply to the Federal Committee on Pest Control for their information. You may wish to seek suggestions from that Committee, if you have not already done so.

If we can be of further assistance or provide additional information on specific questions, we will be glad to do so.

Sincerely yours,
/s/ R. E. Duggan
R. E. Duggan
Deputy Associate Commissioner
for Compliance.

INSECTICIDE USE

The kinds and quantities of insecticides used in the past, those being used now, and those predicted for the future bear directly on the presence and distribution of insecticides in Lake Michigan and on steps to be recommended to decrease the amounts in the lake and its biota. The Committee has exerted effort to compile information on types, amounts, and distribution of insecticides applied in the Lake Michigan drainage basin, and has learned that there are no accurate, consistent compilations of such information. Fragmentary figures are available for some areas and for some insecticides, but extrapolation of these numbers into realistic totals for the drainage basin appears impossible at the present time. Even the following general statements on usage are subject to great error; the values are only general indications and should be used cautiously.

Approximately 1.25 million acres of Indiana land drains into Lake Michigan. Much of this area is heavily industrialized and urbanized and the remainder is devoted to dairy and general farming. About 58,000 acres of Illinois is in the Lake Michigan watershed; most of this area is highly-developed industrial and residential area. The Lake Michigan drainage area in Wisconsin measures about 250 miles long, and up to about 150 miles wide; this area has extensive orchard and other farm acreage, as well as forests. Michigan lands in the drainage basin are extensive, and include approximately one-half of the entire State (approximately 29,100 square miles). In this area are vast forests, numerous Christmas tree farms, and widespread agricultural lands, including the greater part of the Michigan fruit belt.

In 1964 approximately 3.8 million pounds of insecticides were used on crops in the three lake

States of Minnesota, Michigan, and Wisconsin (U.S.D.A., 1968). It is not known what portion of this was applied in the Lake Michigan watershed. In the lake States the greatest amounts of the insecticides were used on apples and other deciduous fruits. Aldrin (that converts to dieldrin) used on the largest acreage on corn, totaled 761,000 pounds on approximately 1.2 million acres. DDT was applied to about 150,000 acres and accounted for 511,000 pounds.

The State of Wisconsin estimates that in its segment of the Lake Michigan drainage basin approximately 150,000 acres of farm lands received 500,000 pounds of technical insecticides in 1967. Of this, 86,600 pounds was DDT, 4,200 pounds was dieldrin, 103,800 pounds was chlordane, and 28,000 pounds was toxaphene. Most of the remainder was composed of non-persistent insecticides.

Based on 1966 insecticide application data and 1964 crop average data, the agricultural use of persistent chlorinated hydrocarbons, in the Michigan portion of the drainage basin is considerably less than the fungicides, phosphates and herbicides. Of the persistent materials, aldrin, DDT, and dieldrin were the most frequently applied and were used primarily on grain crops and fruits. Dieldrin and DDT were applied in much greater amounts before 1966.

The Lake Michigan drainage basin is not typical of the rest of the United States in respect to the distribution of insecticide use. In the corn belt and cotton belt States there is a much higher percentage of insecticide use on field crops, while the basin use is perhaps 60 percent metropolitan and 40 percent agricultural. Throughout the greater part of the Lake Michigan drainage basin municipalities have made heavy use of DDT for control of the lesser European elm bark beetle, the principal vector of Dutch elm disease. The amount of DDT applied to a large elm tree approximates that normally applied per acre for field crop purposes. DDT spraying is largely municipally-sponsored and trees in parks and along streets are sprayed mainly in the spring. Considerable insecticide drops to paved areas and is washed away by stormwater directly into tributaries of Lake Michigan. Mosquito abatement programs are also common in the resort and residential areas in much of the basin. Persistent insecticides applied for the above purposes have less opportunity to become bonded to soil particles than do those applied directly to crop areas for insect control.

The Lake Michigan drainage area must have received immense amounts of pesticides in recent years. Prospective future use, based on present trends, suggests increased emphasis on the less persistent insecticides and decreasing reliance on the persistent chlorinated hydrocarbons.

MONITORING PROGRAMS

It is axiomatic that a program of insecticide measurements in the Lake Michigan environment would have helped us recognize the existence of an insecticide problem, but a monitoring program will be indispensable in following future changes, whether or not a control program is implemented.

Some measurements of insecticides in this ecosystem have been made in recent years. Certain of these programs could be classed as monitoring activities, but data have also been accumulated from individual studies restricted as to times and places. All of these have added to our knowledge and helped form our impressions of the history of insecticides in the water and the animals of Lake Michigan.

During the past three years the Ann Arbor Biological Laboratory of the Bureau of Commercial Fisheries has been measuring insecticide levels in fish from each of the Great Lakes. Some results from these studies are included in Table 1. The same laboratory has collected many water samples from Lake Michigan and has found DDT and dieldrin in measurable amounts.

In the past few years, the Ontario Water Resources Commission has analyzed fish from Lakes Erie and Ontario and other waters.

The U. S. Department of Agriculture conducts the soil monitoring portion of the National Pesticide Monitoring Program, including the Lake Michigan watershed. Sampling began on July 1, 1968, and no results are yet available.

The Wisconsin Department of Natural Resources is studying the sources, seasonal variation, and residues in fish of chlorinated hydrocarbon

Table 1
Pesticide Residues in Whole Fish from
Lake Michigan, 1965-1968*

Species	Number of fish	Pesticide concentration (ppm) Dieldrin	Total DDT (DDT, DDD, DDE)
Alewife	663	0.11	3.93
Chubs	384	0.24	10.11
Smelt	239	0.08	3.01
Perch	200	0.06	3.28
Lake trout			
3-5"	10	0.02	1.07
6-9"	61	0.11	2.99
10-13"	40	0.13	4.31
16-20"	19	0.21	6.64
Coho salmon			
10-22"	15	0.14	3.45
25-30"	4	0.15	12.59

* Bureau of Commercial Fisheries data

insecticides, in the Milwaukee River and its tributaries. The department is also investigating insecticide residues in invertebrate organisms in streams tributary to Lake Michigan.

At the Michigan State University, studies are in progress on the effects of insecticides on populations of salmonids in Lake Michigan, on the nature and metabolic activity of lipids associated with insecticides residues in fish eggs, and on environmental and physiological factors affecting the toxicity of accumulated insecticide residues.

The literature contains recent reports on insecticides in the Lake Michigan drainage, including the Green Bay area. Reports have also been published on herring gull reproduction, occurrence of insecticides in the Lake Michigan ecosystem, and DDT and dieldrin levels in Great Lakes fish. No known programs exist that will indicate the contribution of airborne insecticides to the lake.

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RECOMMENDED MONITORING PROGRAM

A monitoring program would provide up-to-date information on the pesticide contamination within the aquatic ecosystem of Lake Michigan and its drainage basin. Such information would be used in the management and protection of the water resources and specifically for the protection of sport and commercial fish.

To stay within practical limits of time, money and manpower, the Committee recommends a four-point approach to the monitoring program: changes in insecticide levels should be measured in 1) major tributaries; 2) minor tributaries; 3) Lake Michigan water; and 4) fish of Lake Michigan.

Monitoring

To be of greatest value, the monitoring program must include those insecticides of currently acknowledged significance to human health and to growth and reproduction of aquatic life. It must measure quantities at reproducible levels to establish current concentrations and to trace future trends. The Committee has selected seven contaminants (Table 2) and their

Table 2

Insecticides and the Lower Values of Quantitative Reporting Recommended for Various Types of Monitoring.

Insecticide and priority order of analysis	Tributary water µg/l	Lake water µg/l	Fish tissue µg/g	Clam tissue µg/g
DDT	.020	.001	0.1	0.1
Dieldrin	.020	.001	0.1	0.1
DDD	.020	.001	0.1	0.1
DDE	.020	.001	0.1	0.1
Methoxychlor*	----	----	0.1	0.1
Chlordane*	----	----	0.1	0.1
Endrin	----	----	0.01	0.1

* If detected in fish tissue at concentrations greater than 0.1 µg/g, quantitative reporting should be changed to a 0.01 µg/g limit.

levels of detection for routine analysis by gas chromatograph, to provide the information necessary to meet the objectives.

Major Tributaries Recommended for Sampling

The Committee recommends nine major tributaries of Lake Michigan to be sampled continuously for three days (Table 3), once each month. The purpose is to determine the poundage of insecticides supplied by the major tributaries to Lake Michigan. Sampling stations should be located as close to the lake as practical. Two stations are recommended on the Milwaukee River, one near the mouth and one above the industrial area, to differentiate between agricultural and urban contamination. Water samples for pesticides are to be analyzed without filtration; subsamples are to be analyzed for suspended solids and turbidity.

The three-day continuous sampling method is recommended to detect fluctuations in turbidity and pesticide loads. Although the sample volume will not be proportional to stream flow, it can be related to discharge rate to secure quantitative information.

The apparatus for continuous flow sampling

Table 3

Recommended Water Quality Monitoring Stations for Insecticides on Major Tributaries.

River	Proposed station location	Est. mean annual flow (cfs)	Est. mean annual high flow (cfs)	Est. mean annual low flow (cfs)	Watershed (sq.mi.)	Percentage of basin gaged
Fox*	Main St. Bridge, Green Bay, Wis.	4,154	12,983	1,207	6,150	--
Grand** Calumet	Dickey Road, East Chicago, Ind.	864			37	--
Grand	Corps of Engineers, Grand Haven, Mich.	4,000	23,820	924	5,570	88
Kalamazoo	U. S. 31 Bridge, Saugatuck, Mich.	1,722	5,812	512	2,060	78
Manistee	Maple St. Bridge, Manistee, Mich.	2,312	5,937	1,322	2,130	93
Menominee	Ogden St. Bridge, Marinette, Wis. Menominee, Mich.	3,382	15,150	994	4,070	93
Milwaukee ***	Machinery Bay, Milwaukee	385	4,640	28	686	--
Milwaukee	Above urban area	Currently unavailable				
Muskegon	Coast Guard, Muskegon, Mich.	2,176	7,750	698	2,660	88
St. Joseph	Ches. & Ohio RR Bridge St. Joseph, Mich.	2,312	5,937	1,322	2,130	93

* Data from Wrightstown, Wis.

** Data from Gary, Ind. stage-flow relationship plus industrial and municipal discharges.

*** Data from six miles above mouth.

can be a pump with a capacity to deliver about 200cc of stream water per hour into a five-gallon covered bottle. Larger pumps can be used if a bleeder is provided to deliver the indicated amount. (Suitable pumps are commercially available for approximately $50 each.) The water should be drawn through metal tubing from a sectio of stream with a visible current.

Studies at Michigan State University have demonstrated that the majority of phosphorus is carried by a stream during relatively few days of each year. Insecticides are likely to behave similarly and, because data on the total tributary contribution are desired. grab samples are not adequate.

Biological Sampling of Tributaries

The Committee recommends a one-year program of biological monitoring in most tributaries during the ice-free season (Table 4). The main purpose of the monitoring is to identify sources of insecticides from tributaries other than the nine named in the major tributary water sampling program. Living clams will be used to sample water.

TABLE 4

Tributary Streams Recommended for Biological Monitoring

Tributary	Location
Michigan	
Galien River	La Port Road, New Buffalo, Michigan
Drain	Sawyer, Michigan
St. Joseph River*	U.S. 31 Bridge, St. Joseph, Michigan
Paw Paw River	Above St. Joseph, Michigan
Black River	U.S. 31 Bridge, South Haven, Michigan
Kalamazoo River*	U.S. 31 Bridge, Saugatuck, Michigan
Black River	Ottawa Beach, Michigan
Pigeon River	Lake Shore Ave., Port Sheldon, Michigan
Grand River*	Corps of Engineers, Grand Haven, Michigan
Muskegon River*	Coast Guard, Muskegon, Michigan
White River	S. Channel wall, Whitehall, Michigan

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* Water monitoring station for pesticide analysis.

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Tributary	Location
Michigan (cont'd.)	
Pentwater River	Coast Guard, Pentwater, Michigan
Pere Marquette River	Channel area, Ludington, Michigan
Manistee River*	Maple St. Bridge, Manistee, Michigan
Betsie River	Coast Guard, Frankfort, Michigan
Platte River	M-22, Benzie State Park, Michigan
Crystal River	Bay Lane, Glen Arbor, Michigan
Leelanau Lake outlet	Leland, Michigan
Boardman River	Traverse City, Michigan
Elk River	Elk Rapids, Michigan
Lake Charlevoix outlet	Charlevoix, Michigan
Bear River	Petoskey, Michigan
Millecoquins Creek	Naubinway, Michigan
Manistique River	Manistique, Michigan
Sturgeon River	Nahma, Michigan
Whitefish River	U.S. Bridge, Rapid River, Michigan
Escanaba River	Wells, Michigan
Ford River	M-35 Bridge, Ford River, Michigan

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* Water monitoring station for pesticide analysis.

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Tributary	Location
Michigan (cont'd.)	
Menominee River*	Breakwater, Menominee, Michigan
Indiana	
Grand Calumet River*	East Chicago, Indiana
Burns Ditch	Midwest Steel Catwalk, Burns Harbor, Indiana
Trail Creek	Franklin St. Bridge, Michigan City, Indiana
Wisconsin	
Peshtigo River	Marinette County
Oconto River	Oconto County
Pensaukee River	Oconto County
Little Suamico River	Oconto County
East River	Brown County
Suamico River	Brown County
Mink River	Door County
Unnamed Streams (7)	Door County
Ahnapee River	Kewaunee County
Kewaunee River	Kewaunee County
East Twin River	Manitowoc County

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* Water monitoring station for pesticide analysis.

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Tributary	Location
Wisconsin (cont'd.)	
West Twin River	Manitowoc County
Manitowoc River	Manitowoc County
Silver Creek	Manitowoc County
Calvin Creek	Manitowoc County
Pine Creek	Manitowoc County
Point Creek	Manitowoc County
Fisher Creek	Manitowoc County
Centerville Creek	Manitowoc County
Seven Mile Creek	Sheboygan County
Pigeon River	Sheboygan County
Sheboygan River	Sheboygan County
Black Creek	Sheboygan County
Sauk Creek	Ozaukee County
Menomonie River	Milwaukee County
Kinnickinnic River	Milwaukee County
Oak Creek	Milwaukee County
Root Creek	Racine County
Pike River	Kenosha County
Barnes Creek	Kenosha County

Clams siphon and filter large volumes of water and concentrate insecticides to levels many times greater than that of the water. Insecticide levels found in clams reflect concentrations which existed in the water two to three weeks before the sampling time.

Only high insecticide concentrations are of interest on the smaller streams; lower concentrations would not contribute significantly to the total concentration in the lake.

This program should begin in early spring before the insecticide spraying season, and extend into the fall. Clams should be placed in wire baskets suspended a short distance above the stream bottom. The concentration of insecticide in the clams will reach equilibrium in two to three weeks. If exposure ceases, accumulations are lost in approximately the same period. Sufficient numbers of clams should be used so that subsamples of three each can be removed every four to six weeks and at times such as following heavy runoff during peak insecticide application periods.

The single composite sample of three clams may be placed in formalin or frozen before analysis.

Lampsilis siliquoidea, a widely distributed clam found in moving and still water, is the most desirable species. Fusconaia is also suitable, but because concentration rates may vary among species, the same species should be used for all sampling.

The presence of the crystalline style in the esophagus of the clam indicates feeding activity and that the animal has been filtering normally, accumulating extant insecticides. The examination for this structure is rapid and simple and will provide useful information.

Lake Water Sampling

The Committee recommends two sampling areas be established in the central portion of the lake, one in the northern basin and one in the southern basin. Three samples of surface water should be collected three times each year at each station. Horizontal and vertical distribution of insecticide concentrations are not justified for inclusion in this monitoring program since meaningful values would require large numbers of samples and the data would be difficult to interpret.

It is recommended that the water intake

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of the Chicago Central District Filtration Plant be sampled weekly for insecticide analysis. Information furnished by FWPCA's Great Lakes-Illinois River Basin Project indicates that this intake water is representative of open lake water on most days of the year. Unusual weather conditions and wastes and storm runoff entering the lake may alter the quality of this intake water but such effects will be apparent in the routine water quality analyses. The principal purpose of this sampling point is to provide a source of reproducible samples to furnish data on long-term trends. Such information is necessary to evaluate the effectiveness of the insecticide control program.

Fish Sampling

Fish accumulate insecticides to concentrations many times the levels of their surroundings. Analyses of tissue from Lake Michigan fish by Federal and State agencies indicate insecticide levels approaching limits currently suggested by the U.S. Food and Drug Administration. The levels are three to five times higher than those in the same species of fish from the other Great Lakes.

The Committee recommends that four species of fish be collected in April and October at four sampling stations on Lake Michigan. Two samples of ten fish (five of each sex) are to be examined in accordance with the schedule in Table 5.

TABLE 5

Recommended Insecticide Analysis for Fish to be Collected in April and October

Station*	Species	Number of Samples	Composition of Samples
Green Bay	Alewives	2	5 males, whole body
		2	5 females, whole body
	Yellow perch	2	5 males, muscle only
		2	5 females, muscle only
Waukegan, Saugatuck, and Charlevoix	Alewives	2	5 males, whole body
		2	5 females, whole body
	Yellow perch	2	5 males, muscle only
		2	5 females, muscle only
	Chubs	2	5 males, muscle only

Station*	Species	Number of Samples	Composition of Samples
		2	5 males, whole body
		2	5 females, muscle only
		2	5 females, whole body
	Coho Salmon	2	5 males, muscle only
		2	5 females, muscle only

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* Station choice based on location of commercial fisherman and not requiring special collecting.

Assignment of Insecticide Analyses

The Committee has been advised that the city of Chicago will undertake routine insecticide analyses on Lake Michigan water withdrawn at their intake. We therefore recommend that the city be requested to perform analyses for insecticides on open water and intake water samples in accordance with the schedules described above.

The U. S. Department of the Interior, Bureau of Commercial Fisheries Biological Laboratory in Ann Arbor, Michigan, is already measuring insecticide levels in Great Lakes fish, especially those from Lake Michigan. The Committee recommends that this laboratory assume responsibility for collecting and analytical work on the Lake Michigan fish monitoring program. The Committee recommends that Indiana tributary water and clam samples be analyzed by the cooperating laboratory nearest to the sampling site.

Since several laboratories are likely to be involved, a rigid system of quality control is mandatory for comparable data.

Quality Control

Positive identification of all chlorinated hydrocarbons detected, as well as reproducibility and accuracy of the procedure, is of greatest importance. Therefore, the following recommendations are made to assure a reliable quality control program for water, clam and fish samples analyzed during the survey: water samples will be analyzed by the Provisional FWPCA Interim Official Method for Chlorinated Hydrocarbon Pesticides in Water and Wastewater by Gas Chromatography, May 1968. Additionally, a blank with the applicable volume of distilled water, as stated in the procedure, and an actual sample to check percentage recovery of an added mixture of pesticides found in the samples must be determined. One blank and one fortified sample should be interspersed with each nine field samples.

To assist the analyst in identification of suspected pesticides, two separate gas chromatography columns. with different retention times, should be employed to check relative retention time of pesticides in the samples. Further, infrared spectrometry should be employed on five percent of the water samples to confirm the routine analyses. If individual samples do not have sufficient concentration to make infrared measurements, the residues from several samples should be composited, or carbon filters should be used, to secure sufficient quantities of insecticide for positive identification.

Fish and clams will be analyzed by the procedure as outlined in the U.S. Food and Drug Administration Pesticide Analytical Manual, Volumes I and II, Revised January 1968. A reagent and procedure blank, using the method and number as outlined above for water, must be employed. Similarly, the pesticides used in the recovery must be a mixture of those expected to be found in the test organisms and at concentrations comparable to the actual samples. Tissue samples of fish from each sampling location must be verified by positive identification of pesticides at least once each year at each location.

Data will be reported in ug/l for water samples and µg/g (wet weight) for the fish and clams.

Research Needs

Although there is ample evidence that insecticides are a hazard in Lake Michigan, the means of determining the exact detrimental effects, the levels and kinds of insecticides, their distribution in the Lake Michigan environment, and the way in which they enter the lake are not sufficiently known. The Committee strongly recommends that research be immediately initiated to provide the knowledge needed to control pesticides realistically at levels not detrimental to the water uses of Lake Michigan. The specific research needs listed below will provide knowledge needed immediately on the Lake Michigan watershed to control the use of insecticides effectively and to determine what remedial actions are necessary. The Committee realizes that no one agency is capable of conducting all of the needed research and is not, therefore, attempting to recommend who shall do the work.

The significance of research on the following specific problems is vital to evaluation of the effect of insecticides in the Lake Michigan watershed:

1. The effect of insecticide residues in the fish's body, on fish growth and reproduction. Although considerable evidence has been advanced to show that insecticide levels in coho salmon, for example, have affected their reproduction, we do not know the levels that would have no effect in this species. There is increasing evidence that a residue value that is detrimental in one body of water may not be harmful in another aquatic habitat. The research, therefore, must be done on Lake Michigan.

2. The mechanism of insecticide transport into and within the lake. At the present time almost nothing is known about transport of insecticides into Lake Michigan. Results of the monitoring program will partially answer this question, but detailed studies are needed to determine the percentage of insecticides

entering from streams (both dissolved in the water and sorbed on suspended material) and directly to the lake from the atmosphere (rain or wind-carried spray).

3. The effect of bound insecticides (not in solution) on fish. Apparently significant amounts of insecticides reach the lake sorbed to solid particles. Whether they have an effect on fish or are simply lost to the bottom sediments must be known.

4. History of insecticide uses, including amounts and kinds in the Lake Michigan watershed. An effective control program must be based on a knowledge of past history and current status of uses.

5. The persistence of insecticides in the Lake Michigan ecosystem. Knowledge must be gained concerning the time required for the breakdown of toxic insecticides into relatively nontoxic or biologically inactive compounds. This knowledge is necessary to predict the effectiveness of any control program.

6. The effects on terrestrial organisms of insecticides occurring in the aquatic ecosystem. This knowledge is needed to establish residue levels in fish and other aquatic organisms to ensure that there

will be no adverse effect on terrestrial organisms such as fish-eating birds or mammals. This level may be more critical (i.e., lower) than that needed to protect the food organisms itself.

7. Combined effects of a mixture of insecticide compounds on organisms. Since many insecticide compounds occur in Lake Michigan, it is necessary to determine the effects of combinations of known insecticide residues on organisms, in addition to the effects of single compounds.

8. Determination of the proper methods of collection, storage and analysis of samples. This study is essential to the monitoring program recommended by the Committee, and can be a part of that program.

The Committee recommends that immediate attention be given to these eight needs, but with full realization that new research needs will undoubtedly arise as these studies progress.

CONTROL RECOMMENDATIONS

The Lake Michigan Technical Committee on Pesticides recognizes the many and varied uses of pesticides. The Committee feels that each pesticide developed has potentially legitimate uses which warrant the developmental effort; therefore, control over usage should be established with regard to the unique needs for the product, its potential side effects, accumulation potential in the environment, and the hazard of accumulations. The Committee feels that positive action should be taken not only to prevent the accumulation of persistent pesticides, but to reduce their concentration in Lake Michigan waters:

Recommendation No. 1.

> The concentration of DDT in the fish should not exceed 1.0 µg/g; DDD should not exceed 0.5 µg/g; dieldrin should not exceed 0.1 µg/g and all other chlorinated hydrocarbon insecticides, single or combined, should not exceed 0.1 µg/g. Limits apply to both muscle and whole body and are expressed on the basis of wet weight of tissue.

The above values for DDT and DDD are based on evidence that Lake Michigan fish apparently exceed these levels, while fish of the other Great Lakes and inland waters do not. Furthermore, it appears that in coho salmon, and perhaps other fish, reproductive capabilities are inhibited by levels that exceed these values. The 0.1 ug/g recommendation for dieldrin is based on reducing the present level of dieldrin in Lake Michigan fish.

The Committee recognizes that other chlorinated hydrocarbons apparently are not a hazard to Lake Michigan fish at this time, but a reduction in the use of DDT and DDD will result in a shift to other insecticides. It is further recognized that other insecticides may be even less tolerable than DDT and DDD and therefore contamination levels must be established now before such problems develop. The Committee recognizes that, to achieve the recommended reduction of DDT plus analogs and dieldrin in fish, it will be necessary to reduce the concentrations of each product in Lake Michigan waters possibly to less than .001 ug/l. Limits of contamination are given for fish rather than water because the permissible concentration in the water is not known.

D. I. Mount

Recommendation No. 2.

Each State should establish a regulatory authority to control and record type, quantity and place of insecticide use.

This regulatory authority should have the power to evaluate the benefits of particular products and their uses against the potential damages that might be inherent in their use. This regulatory body should be composed of at least one representative each from the disciplines of agriculture, conservation, water pollution, health and administration. The regulatory body would review each known insecticide use in light of its benefits and hazards and subsequently approve or disapprove its use. It would initiate among the representative agencies the necessary monitoring information required to evaluate insecticide sources within the State jurisdiction.

The regulatory authority should also be provided with technical talent capable of reviewing and evaluating the literature that is continuously becoming available. Enforcement of this authority's rules should be clearly identified in the legislation creating the group. Enforcement of policies should be intensive and aggressive to adequately protect the environment from insecticides deemed damaging or unwarranted.

Recommendation No. 3.

A Lake Michigan Interstate Pesticides Committee should be created by the Conferees to attain uniformity among the States in pesticide use controls and establish uniform pesticide concentration limits in fish, water and other aspects of the Lake Michigan ecosystem.

The Committee would review, at least annually, the monitoring results, evaluate the effectiveness of the program, and advise the Conferees on needed changes in the monitoring program. This committee, after evaluating the potential ecological hazards to Lake Michigan, reviewing the inventory of products used, and evaluating uses that contribute significant quantities of insecticides to Lake Michigan, would recommend further action to substantially reduce the insecticide hazard to Lake Michigan.

Recommendation No. 4.

The research needs listed in this report should receive priority equal to that given to the monitoring program.

Recommendation No. 5.

The monitoring program presented in this report, and modified as needed, should be implemented at the earliest possible date and continue as long as the insecticide hazard exists.

Because the insecticides dealt with in this report are persistent, improvement in lake conditions will not appear as soon as sources of contamination are controlled. Only through a continuing monitoring program can the results of the control measures be evaluated.

Prepared by:

Lake Michigan Enforcement Conference
Pesticides Committee, Donald I. Mount, Ph,D.,
Chairman, November 15, 1968.

- - -

MR. STEIN: Thank you, Dr. Mount.

Are there any comments or questions?

Dr. Mount, I think this is an excellent report.

By the way, before we go on, I would like to say that Mr. Richard Nelle is here for Mr. Klassen, who had to leave.

I think we can move on this, but I run into some real problems with it.

If we adopt the figures that you point out for DDT, dieldrin and other chlorinated hydrocarbon insecticides--by the way, why do you use the word "insecticide?" Why not "pesticide?"

DR. MOUNT: Because we found no evidence that fungicides,herbicides, and so on,were a problem in the lake, and it is virtually impossible, without a massive analytical program, to detect these others. It is not a matter of running something through once and getting this.

MR. STEIN: Yes. Well, if you have all other hydrocarbons.

But the point is, supposing we find something exceeding those limits in the tissues of the fish, and I know we have been through this that you do the test, what do we do with that information? How do we relate that to a point of discharge to limit it? Now, if we don't know what is going in or where or whether these limits--or the limits will be effective in cutting it down--in other words, what happens if we find that dieldrin or DDT exceeds this limit? Do we ban it altogether or do we cut down its use or put limitations on its application? Where do we go from this? How does this give us a pollution control?

DR. MOUNT: I don't think that the question you are raising is any different than it would have been had we recommended limits on the water in the open lake. The monitoring program, we feel, is set up so as to identify the tributaries which are making the major contributions or at least giving an estimate of how much each one is putting in.

MR. STEIN: I didn't say it was any different than the water in the lake. But the question--you raised this point on the front page of your report saying that you can't get evidence on the type of insecticides and where they were being used.

Now, the point is, if we don't have that information; if you have this information you give here; or any other indication of a measurement in the lake--unless we can relate that to some kind of application on land, we are not going to be able to put any meaningful control measures into effect, are we?

DR. MOUNT: I am not sure I still completely understand your question.

But let me repeat again, the tributary sampling program should identify those areas where the contributions are coming from, the measurements. Secondly--

MR. STEIN: Supposing you do that--

DR. MOUNT: Secondly, I would like to underline that less than half of the insecticides are used on agricultural land.

MR. STEIN: That is right.

DR. MOUNT: Which means that industrial sources and municipal sources are also suspect.

MR. STEIN: I didn't mention agricultural lands, purposely. This is precisely the point.

Supposing, Don, we do identify a tributary.

What do we do? What I am trying to do is to get some kind of methodology where once you have identified these tributaries we can hopefully come up with a program or at least a recommendation for control. Just identifying a tributary that something comes out of or identifying the material in the fish or in the water is not going to permit us to control the operation.

The question is, unless you know the source, and there can be three sources, three possible ones--and by the way, I don't want to incriminate any one of these, I am just doing these kind of to exhaust the field--either agricultural application, industrial sources or municipal sources, that something is going to come through, and the lady flushing this down her toilet bowl in the aggregate may be just as important as the land runoff.

But until we know this, until we are able to control the source, how are we going to stop this? Do we have a control program, if we are going to recommend one, which will lead to a controlled result? This is what I am getting at, Don.

DR. MOUNT: Perhaps,we felt that the next step was obvious and maybe it isn't. But it seems to me that once you know the tributaries that are most concerned the next logical step is to look at the outfalls and the drainage from agricultural areas to see what the sources on that tributary are.

We have set up a sampling program on one of the rivers, which I can't--it is one in Wisconsin, and I believe it is on--well, I believe it is on the--I won't say. It is one of the rivers in Wisconsin. We have two sampling points on that river specifically for that purpose, to get some feel for the relative contribution from agricultural runoff as compared to industrial or urban area runoff. But I believe you simply go up the stream and locate the sources once you know which tributary it is going in.

MR. STEIN: Don, this is what I am getting at.

By the way, Dr. Mount has done some of the pioneering work here. The point is what he did do, I think, was crack the case where we found fish dying by the millions in the lower Mississippi and discovering the causes of what was killing them. The difficult job that we had was finding where the material came from. We believe--and again I want to say that the people responsible may not agree with this--but we believe we located this, which was a chemical plant manufacturing this, putting it out. We were extremely lucky in finding what we thought was one source and when that stopped the fish haven't died since. So we solved the case. The difficulty, though, is if we are not dealing with one source--and in this case obviously you are not going to find this--we are not going to be that lucky.

What I am wondering is, again, Don, the most difficult thing we have to do is to trace this. Now, do you have a technique or an approach not only to find that this material is coming out in deleterious quantities which should be cut down, but really to pinpoint the sources that it is coming from? Do you have a proposal for that? This is what I am getting at.

DR. MOUNT: No, not specifically.

MR. STEIN: Again, I don't want to delude anyone on this insecticide control problem here. This is a very, very difficult operation. Until we develop this we are not--and I don't say it is luck where you have one major industrial source that you can find and stop, but we can't expect that kind of control situation here. We have to expect if we find that they are coming from municipalities, cities and industries that we have to come up with a split and pinpoint them or else have a product ban, which is a very drastic way of handling things. And I would suggest that this may be a way of looking at this again.

Now let me ask you just one technical question. You talked in terms of gas chromatography and infrared spectroscopy. Let's suppose that we knew what chemicals were being applied in the particular area and you got pure samples of those chemicals. If we checked the products that were being used by municipalities, industries and cities, and you had these pure samples, by using the infrared technique, couldn't you pretty well identify the material we had in the water?

DR. MOUNT: Yes. That is why we have proposed the use of spectroscopy.

MR. STEIN: Again let me give you this. This is one of the new fields that we are getting at.

Presumably, Dr. Mount, using the most sophisticated machines, we can use the infrared spectroscopy and come out with a wiggle line on a sheet of paper which has characteristic ups and downs, hills and valleys. The difficulty is, with all the tens of thousands of millions of substances, you don't know what that is. But if we can get a pure sample of the substance and then pick up a little of this in the water or in the tissue of an animal and run it through and you match the wiggles, it is like a fingerprint and they match; then you have it laid down.

It seems to me an effective control either to test what is coming out or to find this--and we will need the State agriculture departments and everyone to work on this if this is going to work--we are going to need a pretty much complete inventory of what is going into the stream, who is using it and where it is applied before we can have too much success in finding that when we get it in the stream. And I think if you are really serious about controls of this problem, the other aspect that you point out is going to be just as important. I am talking from the regulatory point of view, not the joy of scientific discovery, which is all at the other end. If we are going to do anything about that, we just have to do the hard-nosed work of finding every insecticide, if this is the problem, which is being used in the Michigan Basin States, where they are being applied, how they are being used, and then trace them down to the stream to determine whether they are a problem. Prototype of that material will give us the so-called "fingerprint" to check against when Don finds them in the stream.

I might say this is a very hard and expensive program, and if you want to engage in it, we are ready.

DR. MOUNT: The Committee was especially concerned in regard to the positive identification of pesticides because of the recent evidence that there are a number of plasticizers which have peaks corresponding on the gas chromatograph to measures in chlorinated hydrocarbons and other work done by the Department of Agriculture, I believe, which showed that elemental sulfur had several peaks which corresponded to known hydrocarbon pesticides when analyzed on the gas chromatograph. We talked with a number of chemists--in fact we used many resource people on this--and we invited some of our people from the Athens Analytical Laboratory to talk with us about these problems and we feel reasonably certain that we are not asking for anything especially difficult in doing this infrared analysis. There are other methods of doing this too, but we felt this was perhaps the most feasible plan.

MR. STEIN: This is the one I think that you can train most people to do.

Let me ask you this: Do you have the equipment in Duluth or are we going to have to do this down in Athens, Georgia?

DR. MOUNT: Yes, we have the equipment in Duluth.

MR. STEIN: Do you have people who know how to do it?

DR. MOUNT: Yes, sir.

MR. STEIN: All right.

If we have this--again I throw this open to the Conferees--if you want to engage in this program, this is going to be a hard one. And by the way, there is a lot of built-in opposition, as you may know, to this program. You are taking on another class of potential polluters who haven't considered themselves as being polluters up to now and they are apt to be a little touchy about this. But if you want to do this, the Conferees should indicate this. We can set this program up and try to do this with your cooperation and see if we can trace this and crack one or two of the tributary streams and cut this out and show results. I think the advantage of this kind of work is once you have isolated this and isolated the source and you have stopped it, the results are spectacular. Everyone knows that.

Are there any other questions?

MR. PURDY: Mr. Chairman.

MR. STEIN: Yes.

MR. PURDY: I might ask a question on the capabilities of doing the analytical work in Duluth. Was that answer, say, directed towards all of the monitoring specified in this report or only that monitoring required--

MR. STEIN: Only that monitoring, because

I am sure a lot of the other stuff can be handled by States and other people. The difficulty is this infrared work is kind of advanced. There are not too many machines in the country, and once you get a machine,there are not too many people who can run the machine.

MR. PURDY: Well, it is proposed in the report that a certain part of that monitoring be done at the State levels, including this.

MR. STEIN: Do you have the capacity to do this?

MR. PURDY: Well, that is why I say, in this report, I think we need to take a hard look at it to see where the capabilities lie and the budgetary implications that might be--

MR. STEIN: That is right.

How much does one of those machines cost, Don?

DR. MOUNT: Well, it is like buying a car, of course.

MR. STEIN: Yes.

DR. MOUNT: It depends on where you begin and end. Ours was $20,000.

MR. STEIN: All right. This will give you an idea.

MR. PURDY: I knew what the price was before I asked it.

MR. STEIN: Then you need a $20,000-a-year man to run it, you know, and it depends on whether the State wants to take that on. I wasn't sure we could even do this up here. I thought we may have to ship it out, but I am glad to see we have the capacity.

But we would be delighted if the State people can get that kind of capacity in the State lab to do this kind of work.

MR. PURDY: I think the surveillance proposed in this report will require us to mobilize all of our capabilities at various State institutions and at the Federal level, really. It is not something that we can accomplish tomorrow, but we should work towards that as rapidly as possible.

MR. STEIN: Are there any others?

MR. FRANGOS: Mr. Chairman, I am wondering, assuming you bought a medium-priced line in this equipment, what is the capability in terms of numbers of analyses you might expect a day, assuming an eight-hour day?

DR. MOUNT: Are you talking about the machine time required or the preparation time or both?

MR. FRANGOS: Well, the net effect, how many results can you produce in a day?

DR. MOUNT: There are people here who probably can answer that better than I, but I would suppose that we are talking about--I am going to guess--

MR. FRANGOS: Ball park estimate.

DR. MOUNT: --ten samples a day. You noticed that in our report we have not suggested that all samples be identified by infrared. We believe that compositing, particularly of water samples, for example, can be done without a great loss of precision.

MR. STEIN: By the way, on this you can do a lot of educated guessing and cutting down by more simplified procedures,so the samples you will be running through are your pay dirt samples, hopefully, because otherwise it is prohibitive.

Now, these are the kinds of factors that the State has to consider before they consider getting into this on their own.

MR. FRANGOS: I just want to reemphasize the point you are making, because we have been digging into this thing and there are a lot of questions which are going to take all the way down to this spectroscopy.

MR. STEIN: Yes. Again, I don't want to push this. My notion is in using these sophisticated machines and considering what they can do, as far as a regulatory program, unless we have a man like a Dr. Mount or a Dr. Grezenda * in Athens or Page Nicholson who really know the field and have a pretty good notion of what they find, we find that running the machine just produces blanks day after day. In other words, it takes an artist to run the machine, and this is very much part of the problem.

DR. MOUNT: I might pass on to the Conferees again the feeling of the Committee that because the identification of these insecticides must occur at such a low concentration and because the gas chromatography is such an indefinite identification method, we felt that it was imperative that there be some positive identification by some other method such as the infrared technique.

---

* Dr. Alfred R. Grzenda (deceased)

We feel that it would be better to do less samples and get positive identification on them than to end up with reams of data in which we are not certain of what we have made. A chemist that I respect very much, who is now with industries, once said that knowing the gas chromatographic pattern of a chemical is about equivalent to knowing the weight of a man in order to identify him, and I think this is perhaps a bit far but it is something of the kind of thing we are talking about.

MR. STEIN: Well, maybe. That is for a chemist. I am not sure,given the permutations and combinations,you are likely to find too many.

But again I think your point is well taken. Any time we have a gas chromatographic identification, when we get opposition we have a big fight.

O. K.? Thank you.

May we go on to the coordinated monitoring program.

Mr. Poston.

MR. POSTON: Mr. Pemberton.

While Mr. Pemberton is coming up here, I have a brief statement on research activity of the Federal government in response to Recommendation 22, and I would like to enter it in the record.

MR. STEIN: Without objection, that will be entered into the record as if read.

(The following is the document submitted by Mr. Poston:)

RECOMMENDATION NO. 22

Recommendation No. 22 called for a vigorous pursuit by research into nine pressing water pollution problems of the Lake Michigan Basin. Many of these problems are similar to those of other parts of the country--hence, the summary of research activities presented herein has been compiled from an accounting of all research and demonstration grants or contracts awarded in selected research categories since June 30, 1968. Some additional projects, not included in the tabulation, were initiated during the interval between the Conference adjournment on March 12, 1968, and the June 30 date.

I. The problem of the control of

over-production of algae encompasses four distinct breakdowns (or subprograms) of research as defined by the FWPCA. Seven new projects were funded in the area of concern involving 191,019 Federal dollars. Six projects are of a research nature and one a demonstration.

II. Five subprograms of research are related to the removal of dissolved chemicals (especially nutrients Twenty-eight projects were initiated with $1,902,671 of Federal money. Research projects accounted for $901,930 and demonstration projects $1,000,741.

III. Efforts aimed at the techniques for restoring eutrophic lakes involved eight projects using $291,245 of Federal money for partial support. All of the funds are being used for research activities.

IV. The development of methods relating to the ultimate disposal of residues removed from wastewaters is covered by a single subprogram element. Grants and Contracts in this coding were awarded for five projects involving $454,099.

V. New techniques and methods of improved treatment and handling of industrial wastes should be forthcoming from 27 awards made in the 10 applicable segments of the R & D Program. Total Federal funds committed to these projects is $4,714,992. Demonstration projects account for approximately 94 percent of the total expenditure.

VI. Demonstrations into methods of combating the problems associated with combined sewage and stormwater discharges number 14. Of the $2,732,769 committed, all but 11 percent went toward the combined discharge problem.

VII. No awards have been made to date in the area of effective treatment facilities for ships. Several proposals are presently under review.

VIII. Improved and standardized procedures for water quality tests are a function of both FWPCA in-house research and extramural research. In the latter case, two Federally sponsored projects have been initiated at places other than FWPCA laboratories. Funds committed to this work were $27,303.

IX. Research into improved techniques for water quality monitoring takes into consideration three subprograms of the R & D Program. All together this subject is receiving attention from 15 projects supported in part by 1,166,202 Federal dollars. Demonstration projects received 67 percent of these funds.

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MR. STEIN: Mr. Pemberton.

STATEMENT BY CARLYSLE PEMBERTON, JR.
CHAIRMAN, MONITORING COMMITTEE

MR. PEMBERTON: Mr. Chairman, Conferees and ladies and gentlemen.

In accordance with Recommendation 17 contained in the summary of the first session of this Conference, a Committee of representatives of the five Conferees was organized to develop a recommended State-Federal monitoring program for the Lake Michigan Basin. The Committee report was transmitted to the Conferees in January and I ask that it be entered into the record at this time.

MR. STEIN: Without objection, that will be done.

MR. PEMBERTON: I will now present a

summary of the Committee report.

SAMPLING PROGRAM

The Committee considered the water pollution problems of the basin, as developed at the first session of the Conference, and concluded that a program should be designed to monitor the significant tributary streams near their mouths, and to monitor the open waters of the lake.

The tributary data would provide information needed to determine the total loadings to the lake of important constituents, such as phosphorus, nitrogen, dissolved solids, etc. The data would also provide a means of measuring the success of pollution control programs in the tributary basins.

The lake data would be used to measure the long-term trends in the quality of Lake Michigan waters. FWPCA (then the Public Health Service) sampled the lake during the years 1962-64. The lake monitoring proposed herein would utilize sampling points for which data are available from the earlier surveys, thus providing a basis for comparison. This part of the program would also include the water quality data from water filtration plants arranged for by the States in accordance with Conference Recommendation 19.

In addition, the Committee felt that all public beaches, and other beaches near known or suspected sources of pollution, should be monitored during the recreation season.

The Committee considered the long-term monitoring needs indicated by the Thermal and Nuclear Committee, and by the Pesticides Committee. The former recommends no long-term monitoring, while the latter has developed a specialized monitoring program. It was concluded that in those instances where the monitoring activities could be coordinated, the individual agencies would handle the logistics involved.

The Committee recommends the following sampling program:

1. Each State should monitor a designated list of tributary streams near the points of discharge to Lake Michigan, collecting samples at least monthly, analyzing for a uniform list of 16 basic parameters with additional parameters where needed, and providing related flow data. Illinois will sample one tributary, Indiana

three, Michigan eighteen, and Wisconsin twelve.

2. FWPCA should monitor the open waters of Lake Michigan, sampling a selected list of 51 stations at 3 depths in spring, summer and fall, and analyzing for a selected list of 22 parameters. Analyses for the same parameters should be performed monthly at the nine water plants listed in Recommendation 19 of the summary of the first session of the Conference.

3. The States should monitor all public beaches, beaches adjacent to tributaries with pollutional discharges, and beaches adjacent to high density population areas, collecting samples twice monthly from May 15 to September 15, and analyzing for total coliform and fecal coliform.

METHODS

The Committee recognized that the success of the proposed coordinated effort, involving several laboratories and many scientific and technical personnel, would depend on the ability of the participating agencies to produce comparable data which could be used in assessing basin-wide problems. It was considered to be imperative that techniques used in collecting, preserving and analyzing samples should be as comparable as possible.

The Committee therefore recommends that a committee of laboratory directors be established to adopt uniform procedures. The Committee recommends that the existing Calumet Area Laboratory Directors Committee be expanded to include the principals of the Lake Michigan Conference, and that the laboratory directors of water plants named in Recommendation 19 also be invited to participate.

DATA STORAGE AND EVALUATION

In order that the data generated by the proposed monitoring program be readily available to the participants, the Committee felt that it would be advantageous to have all information stored in one computer facility. FWPCA has access to such a facility, and has an operational system for storage and retrieval of water quality data. The Committee also felt that each agency should be responsible for evaluating and interpreting the data which it collects.

The Committee therefore presents the following recommendations regarding data:

C. Pemberton, Jr.

1. FWPCA should provide data storage and retrieval services, the data to be supplied monthly by the States for storage, and all data to be made available to the States as needed. Data collected at water filtration plants under Recommendation 19, and for the Thermal and Nuclear, and Pesticides Committees should also be stored by FWPCA.

2. Each State and FWPCA should evaluate and interpret data which it collects, in relation to water quality standards, recommendations of this Conference, and long-term trends, and should present results of such evaluation and interpretation at each future progress meeting of the Conference. Periodic evaluation should also be made to determine the adequacy of the sampling programs.

SPECIAL STUDIES

The Committee recognized the inherent problems associated with the sampling of tributaries in urban areas with multiple discharges, artificial channels, semi-inclosed harbors, etc.

The Committee therefore recommends that FWPCA and the States conduct coordinated special studies in problem areas where the proposed routine monitoring indicates the need for additional information.

In conclusion, on behalf of the Monitoring Committee, I ask that the Conferees approve the recommendations contained in the Committee report. I have attached the list of recommendations from the report to this summary for your reference.

Thank you.

MR. STEIN: Thank you, Mr. Pemberton.

(The following is a document submitted by Mr. Pemberton:)

WATER QUALITY MONITORING PROGRAM
for
LAKE MICHIGAN and TRIBUTARY BASIN

REPORT OF THE MONITORING
COMMITTEE FOR THE CONFERENCE
IN THE MATTER OF POLLUTION
OF LAKE MICHIGAN AND TRIBUTARY
BASIN
November 15, 1968

C. Pemberton, Jr.

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Chapter I

INTRODUCTION

In accordance with Recommendation 17 of the summary of the Conference in the matter of pollution of the waters of Lake Michigan and its tributary basin (Illinois-Indiana-Michigan-Wisconsin), a committee was appointed to develop specific recommendations for a coordinated four State-Federal monitoring program in the Lake Michigan Basin and to submit recommendations to the Conferees at the next progress meeting. The committee consisted of:

Carlysle Pemberton, Jr., Chairman, Federal Water Pollution Control Administration, U. S. Department of the Interior, Chicago, Illinois;

Allan R. Black, Division of Environmental Protection, Wisconsin Department of Natural Resources, Madison, Wisconsin;

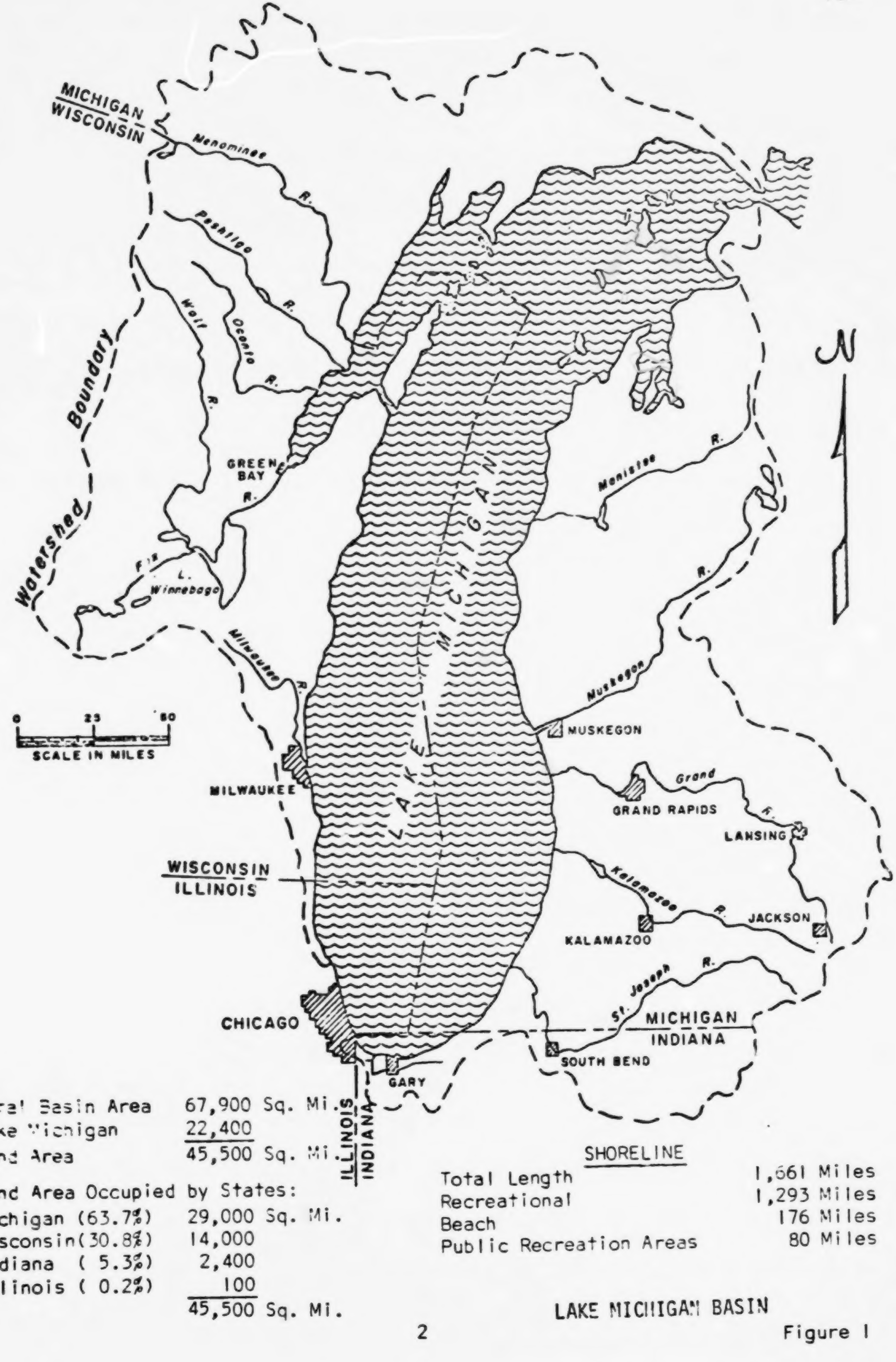
Carl T. Blomgren, Jr., Illinois State Sanitary Water Board, Chicago, Illinois;

John M. Bohunsky, Michigan Water Resources Commission, Department of Natural Resources, Lansing, Michigan;

Oral H. Hert, Indiana Stream Pollution Control Board, Indianapolis, Indiana.

Other individuals who assisted the Committee in preparation of this report were: Robert J. Bowden, Frederic D. Fuller, Almo H. Manzardo and Clifford Risley, Jr., all of the Great Lakes Region, Federal Water Pollution Control Administration.

This report includes the coordinated State and Federal monitoring program proposed by the Committee for the Lake Michigan basin (Figure 1), and recommendations for its implementation. The Committee


MICHIGAN
WISCONSIN
Menominee R.
Peshtigo R.
Wolf R.
Oconto R.
Watershed Boundary
GREEN BAY
R.
L. Winnebago
Milwaukee R.
0 25 50
SCALE IN MILES
MILWAUKEE
WISCONSIN
ILLINOIS
CHICAGO
GARY
ILLINOIS
INDIANA
LAKE MICHIGAN
N
Manistee R.
R.
Muskegon
MUSKEGON
Grand R.
GRAND RAPIDS
LANSING
Kalamazoo R.
KALAMAZOO
JACKSON
St. Joseph R.
MICHIGAN
INDIANA
SOUTH BEND

Total Basin Area	67,900 Sq. Mi.
Lake Michigan	22,400
Land Area	45,500 Sq. Mi.

Land Area Occupied by States:

Michigan (63.7%)	29,000 Sq. Mi.
Wisconsin (30.8%)	14,000
Indiana (5.3%)	2,400
Illinois (0.2%)	100
	45,500 Sq. Mi.

SHORELINE

Total Length	1,661 Miles
Recreational	1,293 Miles
Beach	176 Miles
Public Recreation Areas	80 Miles

LAKE MICHIGAN BASIN

Figure 1

considered the water pollution problems of the basin and reviewed existing State and Federal monitoring programs as they relate to the Lake Michigan basin needs. The Committee determined that additional sampling stations and analyses were required to provide adequate monitoring coverage. The expanded program has been designed to monitor the tributaries near their mouths for the purpose of determining constituent loadings, and to measure the long-range trends in the quality of Lake Michigan. The program also includes the water quality analyses at water filtration plants as arranged by the States (Recommendation 19).

The Committee considered the long-range monitoring needs of the Thermal and Nuclear Committee (Recommendation 10), and of the Pesticides Committee (Recommendation 15). The Thermal and Nuclear Committee recommends no long-term monitoring. The Pesticides Committee has developed a biological, surface water, and fish monitoring program to establish present concentrations of pesticides in the lake and tributary waters and to trace future trends. In reviewing the requirements of these Committees, it was concluded that their specialized monitoring activites should not be included in the Monitoring Committee Report. It was decided that in those instances where monitoring activities could be coordinated, the individual States could determine the logistics of its program.

Chapter II

RECOMMENDATIONS

It is recommended that:

1. Each State monitor its tributary streams near the points of discharge to Lake Michigan. Tributary streams to be monitored are listed in Table 1 and shown in Figure 2.

2. Tributary stream samples be collected at least monthly and analyzed for the parameters shown in Table 3.

3. All public beaches, beaches adjacent to all tributaries with pollutional discharges and beaches adjacent to all high density population areas be sampled twice monthly from May 15 to September 15. Samples should be analyzed for total coliform and fecal coliform.

4. The Federal Water Pollution Control

Administration monitor the open waters of Lake Michigan. Station locations are listed in Table 5 and shown on Figure 2.

5. The open water samples be collected during the spring, summer and fall of each year. A list of parameters to be analyzed is tabulated in the report on pages 20 and 21.

6. Flow data at all tributary monitoring stations be made available by the States.

7. In consideration of Recommendation 19, which requires water quality analysis from nine water filtration plants, the twice weekly analysis include at least alkalinity, hardness, turbidity, coliform bacteria and plankton algae. In addition, monthly analysis should include the parameters recommended for open waters.

8. Techniques used in collecting, preserving and analyzing samples be as comparable as possible. To facilitate the adoption of uniform procedures, a committee of laboratory directors representing the Conferees should be established. It is suggested that the Calumet Area Laboratory Directors Committee, which was created in response to the needs of the 1965 Calumet

Area Enforcement Conference, be expanded to include the principals of the Four-State Enforcement Conference, and that the water filtration plant laboratory directors be invited to participate.

9. The Federal Water Pollution Control Administration act as a central information center for the data generated by the State and Federal Lake Michigan monitoring program and the date be made available for the use of each of the participating agencies.

10. Data collected from water intakes under Recommendation 19, and for the Thermal and Nuclear, and Pesticides Committees, be entered into the central information facility. Analytical methods and reporting procedures should be comparable and consistent with those to be established by the proposed committee of laboratory directors.

11. Special coordinated State and Federal intensive sampling surveys be conducted at harbor areas and tributaries where routine investigations indicate the need for additional studies.

12. Each State water pollution control agency and the Federal Water Pollution Control Administration

evaluate and interpret data collected by that agency in relation to water quality standards, recommendations of the Lake Michigan Enforcement Conference and long-term trends, and present results of such evaluation and interpretation at each future progress meeting of the Conferees. In addition, the data collected should be periodically evaluated for adequacy of each station location, parameters analyzed and sampling frequency.

Chapter III

TRIBUTARY MONITORING PROGRAM

The Tributary Monitoring Program, as recommended by the Monitoring Committee, includes a network of 34 sampling locations of which one is located in Illinois, three in Indiana, eighteen in Michigan and twelve in Wisconsin. Water quality data obtained from the proposed network of stations will reflect input conditions of all major and other significant tributaries to Lake Michigan. The locations of the stations are shown in Figure 2, and listed in Table 1.

Locations of sampling stations were selected by the individual States from their knowledge of land base activities and its relationship to water quality conditions. Stations were located as near the mouth as possible so as to measure the quality characteristics of the tributary just prior to its inflow to Lake Michigan. Such factors as wind, location of wastewater discharges, flow path of effluents, flow diversion and other factors were considered during the selection of sampling sites.

Each station should be sampled in accordance with the sampling schedule shown in Table 3. A list of 40 parameters (Table 2) has been developed to define tributary water quality characteristics. The significance of these parameters are summarized in the Appendix. Included in the list are 16 parameters proposed for routine monthly analyses for all tributaries, 11 parameters measured monthly on a "where appropriate" basis, and 13 optional parameters. The "optional" parameters are those additional analyses presently being analyzed by some of the States. The parameters identified as "where appropriate" are those to be measured where land based activities and high population densities indicate the need for such analyses. Stations designated for the "where appropriate" parameters (mostly heavy

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metals) should initially be tested for six months and then evaluated to determine if continued testing for these parameters is warranted.

Quantitative benthos analyses should be performed on either bottom or substrate samples, depending on the procedure selected by the State, at each of the 34 tributaries identified in Table 1. It is recommended that such samples be collected for analyses during August 1 to September 15 of each year to allow direct comparison of results.

Each State will sample its own tributary streams and be responsible for the analyses. Water quality and benthic data obtained for each station will be forwarded to the Lake Michigan Basin office on a monthly basis for storage into the computer. Average daily flow data for each sampling station will be provided by each State agency for each sampling day. Flow information will be provided annually or more frequently depending on the availability of such information. A list of existing and proposed tributary gaging stations from which flow data will be developed is shown in Table 4.

The Committee has considered the value

of chemical analyses of bottom sediment samples for the Tributary Monitoring Program, but felt that the present sampling procedures will not produce representative results at the proposed sampling points. New methods are currently being developed and field tested which would quantitatively measure sediment deposition. When these methods are sufficiently developed sedimentation sampling should be considered as an addition to the Tributary Monitoring Program.

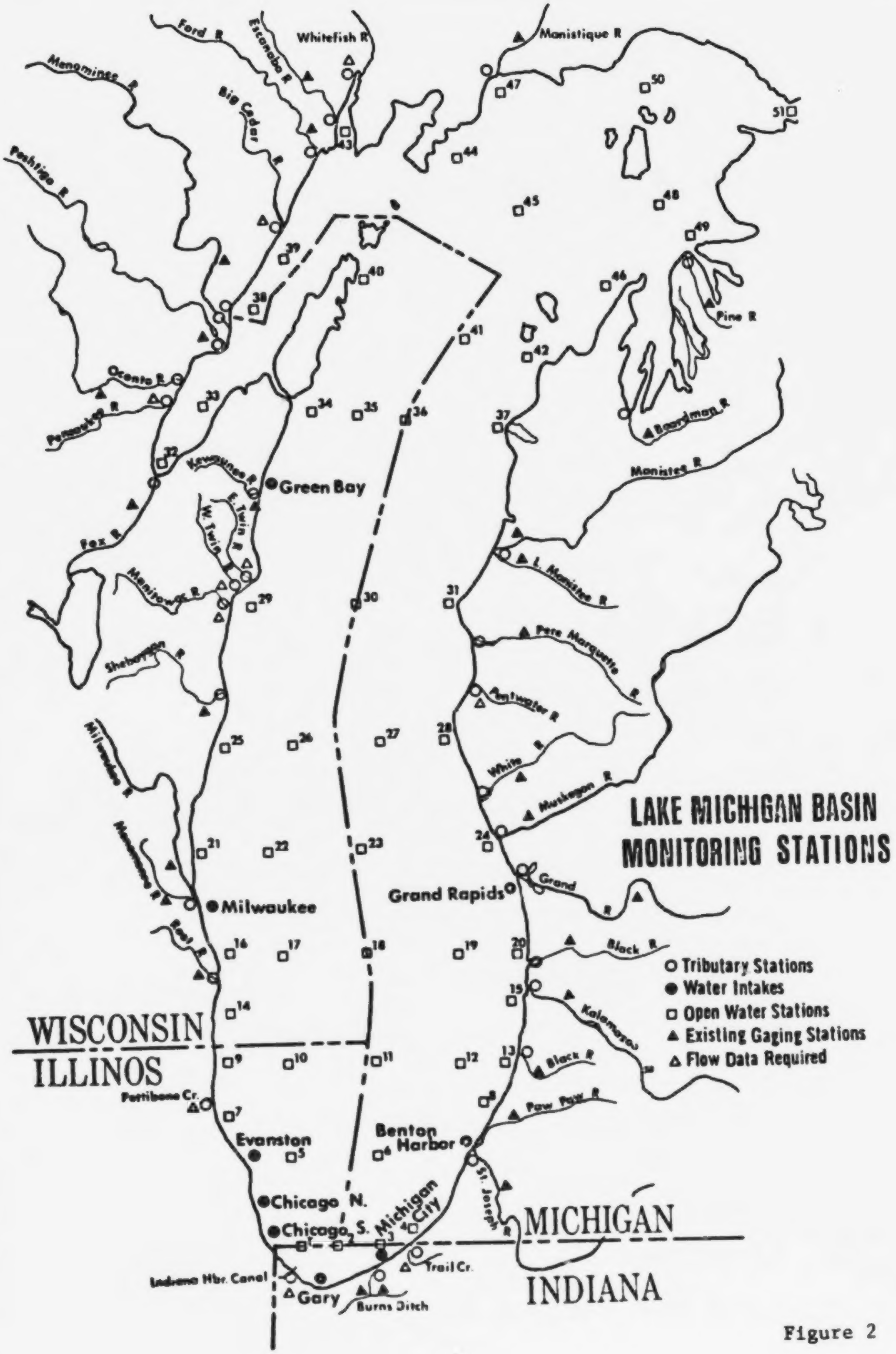
LAKE MICHIGAN BASIN
MONITORING STATIONS
○ Tributary Stations
● Water Intakes
□ Open Water Stations
▲ Existing Gaging Stations
△ Flow Data Required
WISCONSIN
ILLINOS
MICHIGAN
INDIANA
Green Bay
Milwaukee
Evanston
Chicago N.
Chicago S.
Gary
Michigan City
Benton Harbor
Grand Rapids
Ford R
Escanaba R
Whitefish R
Manistique R
Menominee R
Big Cedar R
Peshtigo R
Oconto R
Pensaukee R
Fox R
Kewaunee R
E. Twin R
W. Twin
Manitowoc R
Sheboygan R
Milwaukee R
Menomonee R
Root R
Pettibone Cr.
Indiana Hbr. Canal
Burns Ditch
Trail Cr.
St. Joseph R
Paw Paw R
Black R
Kalamazoo
Grand R
Muskegon R
White R
Pentwater R
Pere Marquette R
L. Manistee R
Manistee R
Boardman R
Pine R

Figure 2

TABLE 1

STATE TRIBUTARY MONITORING STATIONS

ILLINOIS

1. Pettibone Creek (Great Lakes Training Center in yacht basin).

INDIANA

1. Burns Ditch (Midwest Steel catwalk at mouth).
2. Trail Creek (Second Street bridge in Michigan City).
3. Indiana Harbor (Bridge on Dickey Road at East Chicago).

MICHIGAN

1. Big Cedar River (M-35 Bridge in Menominee County).
2. Black River (South wall of channel across from State Park in Holland).
3. Black River (Dyckman Ave. bridge in South Haven).
4. Boardman River (Park Street Bridge in Traverse City).
5. Escanaba River (U.S. Highway 41 and 2 bridge at Escanaba).
6. Ford River (Route 35 bridge at Ford River).
7. Grand River (South wall of channel below Corps

TABLE 1 (Cont'd.)

of Engineers office in Grand Haven).

8. Kalamazoo River (U.S. Highway 31 bridge in Saugatuck).
9. Manistee River (Maple Street bridge in Manistee).
10. Manistique River (West wall of channel south of Ann Arbor R.R. Co. Ferry Slip).
11. Menominee River (Ogden Street bridge in Marinette-Menominee).
12. Muskegon River (South wall of channel at Coast Guard Station in Muskegon).
13. Pentwater River (North wall of channel at Coast Guard Station in Pentwater).
14. Pere Marquette River (North wall of channel at Coast Guard Station in Ludington).
15. Pine River (North bank at U.S.Highway 31 bridge in Charlevoix).
16. St. Joseph River (C&O Railroad Bridge below U.S. Highway 31 in St. Joseph).
17. White River (South wall of channel near red tower near Whitehall).

TABLE 1 (Cont'd.)

18. White Fish River (U.S. Highway 2 bridge at Rapid River).

WISCONSIN

1. East Twin River (17th Street bridge in Two Rivers).
2. Fox River (Mason Street bridge in Green Bay; in winter at DePere Dam).
3. Kewaunee River (County Trunk E bridge*).
4. Manitowoc River (Tenth Street bridge in Manitowoc).
5. Menominee River (Upper Dam at Marinette).
6. Milwaukee River (Machinery Bay near mouth).
7. Oconto River (Highway 41 in Oconto).
8. Pensaukee River (County Trunk S bridge).
9. Peshtigo River (Highway 41 bridge in Peshtigo).
10. Root River (Marquette Street bridge in Racine).
11. Sheboygan River (Eighth Street bridge in Sheboygan).
12. West Twin River (State Highway 42 bridge in Two Rivers*).

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* Tentative Sampling Location.

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TABLE 2

LAKE MICHIGAN TRIBUTARY INFLOW PARAMETERS

(Monthly Analyses Except as Noted)

ALL TRIBUTARIES (16)

1. Alkalinity, Total as $CaCO_3$
2. Biochmeical Oxygen Demand, BOD_5
3. Chloride
4. Coliform, Fecal
5. Coliform, Total
6. Dissolved Oxygen, DO
7. Hardness as $CaCO_3$
8. Nitrate - Nitrite as N
9. Nitrogen, Ammonia as N
10. Nitrogen, Organic as N.
11. pH (field determination)
12. Phosphorus, Total as P
13. Solids, Dissolved
14. Solids, Suspended
15. Solids, Volatile Suspended
16. Temperature

Visual observations should be made at the

TABLE 2 (Cont'd.)

time of sampling for floating debris, oil, grease, scum, sludge solids, color, odor and turbidity.

OPTIONAL (13)

(Frequency determined by the States, see Table 3)

17. Alkalinity, P*, as $CaCO_3$
18. Calcium
19. Color
20. Conductivity
21. Fluorides
22. MBAS
23. Magnesium
24. Phosphorus, Soluble as P
25. Potassium
26. Radiation, Gross Alpha
27. Radiation, Gross Beta
28. Sodium
29. Turbidity

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* Phenolphthalein

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TABLE 2 (Cont'd.)

WHERE APPROPRIATE (11)

(Monthly frequency - may be dropped after six months if no significant amount found)

30. Cadmium
31. Chromium
32. Copper
33. Cyanide
34. Iron, Total
35. Lead
36. Manganese
37. Nickel
38. Phenolic Compounds
39. Sulfate
40. Zinc

TABLE 3
RECOMMENDED ANALYTICAL SCHEDULE FOR TRIBUTARY MONITORING STATIONS

	Parameters / Tributary Monitoring Stations	ILL.	INDIANA			MICHIGAN																		WISCONSIN											
		Pettibone Creek	Burns Ditch	Trail Creek	Indiana Harbor	Big Cedar River	Black River-Holland	Black River S.Haven	Boardman River	Escanaba River	Ford River	Grand River	Kalamazoo River	Manistee River	Manistique River	Menominee River	Muskegon River	Pentwater River	PereMarquette River	Pine River	St. Joseph River	White River	Whitefish River	East Twin River	Fox River	Kewaunee River	Manitowoc River	Menominee River	Milwaukee River	Oconto River	Pensaukee River	Peshtigo River	Root River	Sheboygan River	West Twin River
1	Alkalinity, Total as $CaCO_3$	M	T	T	T	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
2	Alkalinity, P, as $CaCO_3$*																							M	M	M	M	M	M	M	M	M	M	M	M
3	Biological Oxygen Demand, BOD5	M	T	T	T	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
4	Cadmium**	M					M	M				M	M	M		M	M		M		M	M			M		M		M						
5	Calcium*		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q												
6	Chloride	M	T	T	T	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
7	Chromium**	M	M		M		M	M				M	M	M		M	M		M		M	M			M		M		M						
8	Color*		T	T	T																			M	M	M	M	M	M	M	M	M	M	M	M
9	Conductivity*	M	T	T	T	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M												
10	Copper**	M	M		M		M	M				M	M	M		M	M		M		M	M			M		M		M						
11	Cyanide**	M	M		M		M	M				M	M	M		M	M		M		M	M			M		M		M						
12	Dissolved Oxygen, DO	M	T	T	T	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
13	Fluorides*	M			M		M	M				M	M	M		M	M		M		M	M			M		M		M						
14	Hardness, as $CaCO_3$	M	T	T	T	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
15	Iron, Total**	M	M	M	M		M	M		M		M	M	M		M	M		M		M	M			M		M		M						
16	Lead**	M					M	M				M	M	M		M	M		M		M				M		M		M						
17	Magnesium*					Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q												
18	Manganese**	M	M		M		M	M				M	M	M		M	M		M		M	M			M		M		M						
19	MBAS*	M																																	
20	Nickel**	M	M		M		M	M				M	M	M		M	M		M		M	M			M		M		M						
21	Nitrate - Nitrite as N	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
22	Nitrogen, Ammonia as N	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
23	Nitrogen, Organic as N	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
24	pH (field determination)	M	T	T	T	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
25	Phenolic Compounds**	M	M	M	M		M	M				M	M	M		M	M		M		M	M			M		M		M						
26	Phosphorus, Soluble as P*					M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
27	Phosphorus, Total as P	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
28	Potassium*		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q												
29	Radiation, Gross Alpha*	M																							M			M	M						
30	Radiation, Gross Beta*	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M			M	M						
31	Sodium*		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M												
32	Solids, Dissolved	M	T	T	T	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
33	Solids, Suspended	M	T	T	T	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
34	Solids, Volatile Suspended	M	T	T	T	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
35	Sulfate**	M	M	M	M					M		M	M	M	M	M	M				M	M			M			M							
36	Temperature	M	T	T	T	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
37	Turbidity*	M	T	T	T	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M												
38	Zinc**	M	M		M							M	M	M		M	M		M		M	M			M		M		M						
39	Fecal Coliform	M	T	T	T	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
40	Total Coliform	M	T	T	T	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M

Analytical Frequency: M - Monthly, T - Twice Monthly, Q - Quarterly *Optional **Where Appropriate

TABLE 4

TRIBUTARY GAGING STATION LOCATIONS

ILLINOIS

1. Pettibone Creek (flow data required)

INDIANA

1. Burns Ditch
    a. USGS 0935, on left bank on downstream side of bridge on Central Avenue, 0.4 mile east of Gary and 0.4 mile downstream from confluence of Deep River and Little Calumet River.
    b. USGS 0940, Little Calumet River, near center of span downstream side of highway bridge, 3/4 of a mile northwest of Porter and 4.5 miles upstream from Salt Creek.
2. Trail Creek (flow data required)
3. Indiana Harbor (flow data required)

MICHIGAN

1. Big Cedar River (flow data required)
2. Black River, USGS 1088, on left bank 20 ft upstream from bridge on State Road, 0.2 mile downstream from South Branch, and 2-1/2

TABLE 4 (Cont'd.)

miles south of Zeeland.

3. Black River, USGS 1027, on left bank 50 ft upstream from bridge on 66th Street, 4.9 miles northwest of Bangor.

4. Boardman River, USGS 1270, on right bank 25 ft downstream from Brown's Bridge, 300 ft downstream from East Creek, 0.9 mile downstream from Brown's Dam, 1.0 mile northeast of Mayfield, and 9.6 miles southeast of Traverse City.

5. Escanaba River, USGS 590, on right bank 50 ft downstream from Highway Bridge, half mile downstream from Bobs Creek, three-quarters of a mile northeast of Cornell, and 16 miles upstream from mouth.

6. Ford River, USGS 595, on right bank 40 ft downstream from county highway bridge, 1.4 miles downstream from Tenmile Creek, and 1-1/2 miles north of Hyde.

7. Grand River, USGS 1190, on right bank 500 ft upstream from bridge on Fulton Street, 1.7

TABLE 4 (Cont'd.)

miles upstream from Plaster Creek, and at mile 41.

8. Kalamazoo River, USGS 1085, on left bank 40 ft upstream from bridge on State Highway 89, 2.1 miles downstream from Swan Creek, 4.0 miles downstream from Calkins Dam, and 6.1 miles east of Fennville.

9. Manistee River, USGS 1260, on right bank 6.4 miles northeast of Manistee, 6.4 miles south of Onekama, 7.8 miles upstream from Manistee Lake, and at mile 10.8.

10. Manistique River, USGS 565, on left bank 1 mile downstream from West Branch, 6 miles northeast of Manistique, and at mile 19.5.

11. Menominee River, USGS 670, on left bank at powerplant of Wisconsin Public Service Corp., 0.5 mile upstream from Little Cedar River, 3.6 miles southeast of Koss, and at mile 24.7.

12. Muskegon River, USGS 1220, on left bank in tailrace of powerplant operated by Consumers Power Co. at Newaygo, 600 ft downstream from

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TABLE 4 (Cont'd.)

Penoyer Creek and at mile 39.1.

13. Pentwater River (flow data required)

14. Pere Marquette River, USGS 1225, on right bank 20 ft upstream from highway bridge at south edge of Scottville and 5-3/4 miles downstream from South Branch.

15. Pine River, State Gage, north bank at U.S. Highway 31 bridge in Charlevoix.

16. St. Joseph River, USGS 1020, on right bank 20 ft upstream from bridge on Indian Lake Road.

Paw Paw River, USGS 1025, on right bank 200 ft downstream from County Highway Bridge, three-quarters of a mile east of Riverside. Prior to May 10, 1966, at site 250 ft upstream.

17. White River, USGS 1222, on right bank 30 ft downstream from bridge on Fruitvale Road, 6.3 miles downstream from North Branch, and 6.9 miles northeast of Whitehall.

18. Whitefish River (flow data required)

TABLE 4 (Cont'd.)

WISCONSIN

1. East Twin River (flow data required)
2. Fox River, USGS 845, at Rapide Croche Dam, 2 miles upstream from Wrightstown, and 18 miles upstream from mouth.
3. Kewaunee River, USGS 852, on left bank just downstream from bridge on County Trunk F, 2.3 miles west of Kewaunee.
4. Manitowoc River (flow data required)
5. Menominee River, USGS 670, on left bank at powerplant of Wisconsin Public Service Corp., 0.5 mile upstream from Little Cedar River, 3.6 miles southeast of Koss, and at mile 24.7.
6. Menominee River, USGS, 871.2, near left bank on downstream side of 70th Street bridge in Wauwatosa, 800 ft downstream from Honey Creek, and 6-1/4 miles upstream from mouth.
7. Milwaukee River, USGS 870, on left bank near northeast limits of Milwaukee in Estabrook Park, 2,000 ft downstream from Port Washington Road Bridge and 6 miles upstream from mouth.

TABLE 4 (Cont'd.)

8. Oconto River, USGS 710, on left bank just upstream from highway bridge, 2 miles upstream from Christy Brook, 2 miles south of Gillett, and at mile 29.
9. Pensaukee River (flow data required)
10. Peshtigo River, USGS 695, on left bank 75 ft downstream from Chicago and Northwestern Railway bridge, 0.5 mile downstream from Wisconsin Public Service Corp. powerplant in Peshtigo, and 11-1/2 miles upstream from mouth.
11. Root River, USGS 872.4, on left bank 30 ft downstream from State Highway 38 bridge in Racine, 350 ft downstream from Horlick Dam, and 5.2 miles upstream from mouth.
12. Sheboygan River, USGS 860, on left bank 0.7 mile upstream from bridge and State Highway 28, near west city limits of Sheboygan, and 4.2 miles upstream from mouth.
13. West Twin River (flow data required)

- - -

Chapter IV

BEACH MONITORING PROGRAM

The Shores of Lake Michigan are used extensively for full body contact water recreational activities. The Committee suggests, therefore, that the States arrange for a sampling program at least twice monthly at: 1) all public beaches, 2) beaches adjacent to tributaries with pollutional discharges and 3) beaches adjacent to high density population areas. The samples should be collected from May 15 to September 15 and be analyzed for total coliform and fecal coliform by the membrane filter technique. Results of these samples should be forwarded to the Federal Water Pollution Control Administration, Chicago Regional Office, monthly for inclusion into the data storage system.

Chapter V

MONITORING PROGRAM FOR THE OPEN WATERS OF LAKE MICHIGAN

The Federal Water Pollution Control Administration (then the Public Health Service) surveyed the open waters of Lake Michigan during the 1962-1964 Great Lakes-Illinois River Basins study.

The Monitoring Committee proposes that

an open water surveillance program be established utilizing some of the sampling points for which historical data is available. The sampling program should consist of the 51 stations shown on Figure 2 and identified in Table 5. Each station should be sampled at least three times per year, once each during the spring, summer and fall seasons. Samples should be collected from near the surface, at mid-depth, and near the bottom at each station when the lake is not stratified. Where the lake is stratified, samples should be collected at the surface, just above and below the thermocline, and near the bottom. Temperature profiles should be made at each station in order to determine the location of the thermocline. A map of the bottom topography of Lake Michigan is shown in Figure 3.

The 22 parameters selected by the Committee to evaluate open water quality at each station are:

1. Ammonia
2. Calcium
3. Chloride
4. Color, True

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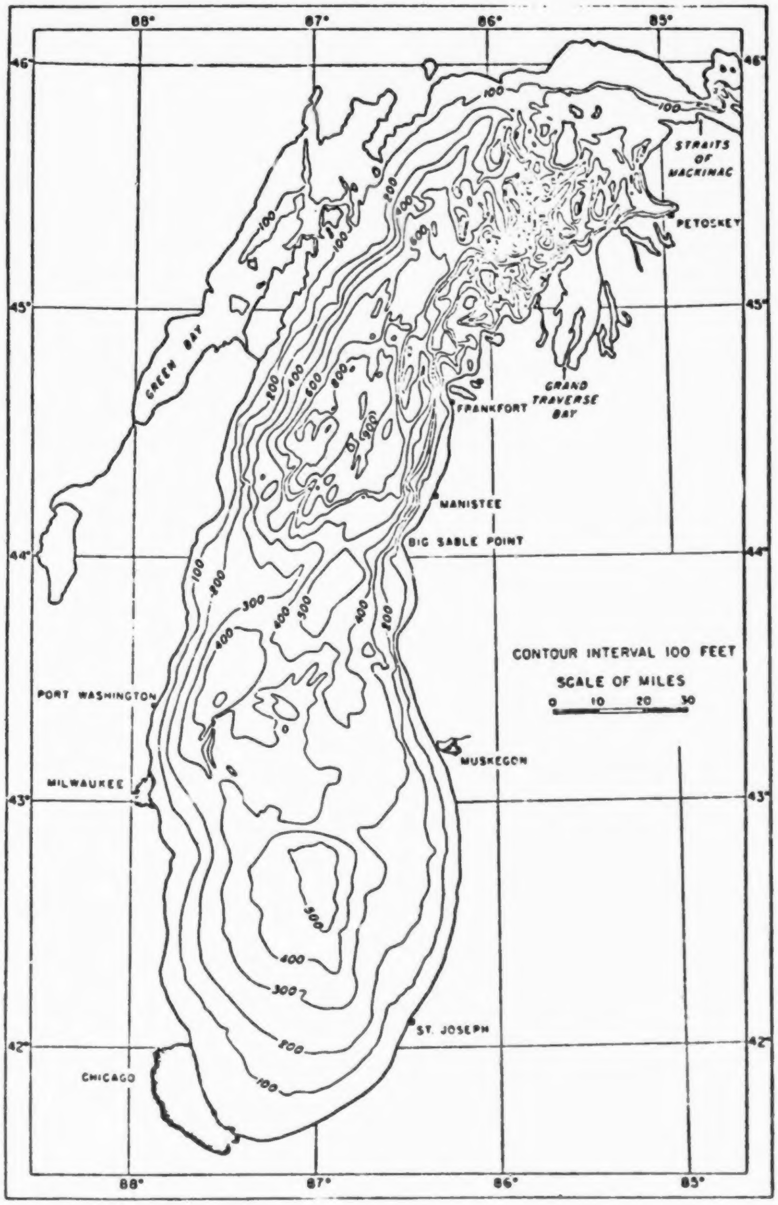
5. Dissolved Oxygen
6. Magnesium
7. Nitrate as N
8. Nitrogen, Organic as N
9. pH
10. Phosphorus, Total as P
11. Phytoplankton
12. Potassium
13. Radiation, Gross Alpha
14. Radiation, Gross Beta
15. Silica
16. Sodium
17. Solids, Dissolved
18. Solids, Suspended
19. Sulfate
20. Total Plate Count
21. Turbidity
22. Zooplankton

The significance of each parameter is summarized in the Appendix. Bottom sediments should be analyzed for Chemical Oxygen Demand (COD), total phosphorus, iron, oil and grease, and percent volatile solids


88°
87°
86°
85°
46°
45°
44°
43°
42°
100
200
300
400
500
600
800
900
GREEN BAY
STRAITS OF MACKINAC
PETOSKEY
GRAND TRAVERSE BAY
FRANKFORT
MANISTEE
BIG SABLE POINT
PORT WASHINGTON
MILWAUKEE
MUSKEGON
ST. JOSEPH
CHICAGO
CONTOUR INTERVAL 100 FEET
SCALE OF MILES
0 10 20 30

SOURCE: Reprinted from *Geology of the Great Lakes*, by Jack L. Hough.

BOTTOM TOPOGRAPHY
LAKE MICHIGAN

Figure 5

TABLE 5

LAKE MICHIGAN OPEN WATER MONITORING STATIONS

STATION	LONGITUDE	LATITUDE	PREVIOUS VISITS	STATION	LONGITUDE	LATITUDE	PREVIOUS VISITS
1	41°46'00"	87°20'00"	3	27	43°36'00"	86°47'00"	2
2	41°46'00"	87°13'00"	4	28	43°36'00"	86°33'00"	4
3	41°46'00"	87°00'00"	3	29	44°05'00"	87°34'00"	3
4	41°48'00"	86°53'00"	1	30	44°05'00"	87°00'00"	2
5	42°00'00"	87°25'00"	2	31	44°05'00"	86°33'00"	2
6	42°00'00"	87°00'00"	3	32	44°35'35"	87°57'19"	1*
7	42°12'00"	87°43'00"	3	33	44°50'20"	87°45'55"	1*
8	42°14'00"	86°28'00"	1	34	44°47'00"	87°14'00"	2
9	42°24'00"	87°47'00"	3	35	44°45'00"	87°00'00"	2
10	42°23'00"	87°25'00"	2	36	44°43'00"	86°44'00"	2
11	42°23'00"	87°00'00"	2	37	44°30'00"	86°17'00"	4
12	42°23'00"	86°35'00"	4	38	45°05'00"	87°31'00"	2
13	42°23'00"	86°20'00"	1*	39	45°23'30"	87°16'20"	1*
14	42°37'00"	87°45'00"	1*	40	45°14'00"	86°53'00"	1*
15	42°37'00"	86°18'00"	1*	41	45°02'00"	86°24'00"	1
16	42°47'00"	87°41'00"	2	42	44°56'00"	86°05'00"	3
17	42°44'00"	87°25'00"	1*	43	45°45'38"	87°02'45"	1*
18	42°44'00"	87°00'00"	2	44	45°34'00"	86°21'00"	2
19	42°44'00"	86°35'00"	3	45	45°32'00"	86°10'00"	2
20	42°44'00"	86°15'00"	4	46	45°13'00"	85°40'00"	2
21	43°08'00"	87°53'00"	3	47	45°56'00"	86°14'00"	3
22	43°08'00"	87°25'00"	3	48	45°31'00"	85°25'00"	3
23	43°08'00"	87°00'00"	3	49	45°21'00"	85°20'00"	2
24	43°08'00"	86°19'00"	4	50	45°53'00"	85°36'00"	3
25	43°36'00"	87°44'00"	3	51	45°48'00"	84°45'00"	3
26	43°36'00"	87°22'00"	3				

*Only one visit was made to actual position but several other positions within one mile were also sampled.

in addition to the determination of benthic population.

Water and sediment samples should be analyzed for copper, chromium, cadmium, lead, nickel and zinc once every five years to detect any accumulation of these elements in the lake. After two years of operation, the data from the open water should be evaluated to determine if station parameters can be eliminated or if additional stations and parameters are required.

The proposed network of 51 stations is supplemented by the 9 water intake sampling points selected by the Conferees.

Chapter VI

UNIFORM SAMPLING AND ANALYTICAL PROCEDURES

In order to properly evaluate changes in water quality throughout the basin, data obtained from monitoring stations must be uniformly reliable. Techniques used in collecting, preserving and analyzing samples should be sufficiently comparable so that data are similar. A review of existing procedures indicates that for some parameters the analytical methods in current use will probably not produce consistent data. A review of current methods in use by the States and the Federal Water Pollution Control Administration is shown in Table 6.

It is recommended that a committee be appointed for the purpose of establishing mutually acceptable procedures which will assure that the monitoring data produced will be similar. It is further recommended that the Calumet Area Laboratory Directors Committee, which was created in response to the needs of the 1965 conference on the Calumet Area, be expanded to include the principals of the Four-State Enforcement Conference and that the water filtration plant laboratory directors be invited to participate.

Chapter VII

WATER FILTRATION PLANT DATA OBTAINED UNDER RECOMMENDATION 19

Recommendation 19 of the Conference Summary requires the State water pollution control agencies to arrange for a broad spectrum of water quality analyses, including planktonic algae counts, to be performed at least twice weekly at the following water filtration plants: Green Bay, Milwaukee, Evanston, Chicago (both plants), Gary, Michigan City, Benton Harbor and Grand Rapids (see Figure 2). The results are to be reported annually to the Conferees. It is recommended that the twice weekly analyses include at least alkalinity, hardness, turbidity, coliform bacteria and planktonic algae. In addition, monthly analyses should include the parameters recommended for open water sampling stations.

The Committee considers these intakes an essential part of the open water monitoring program, and the data collected from the intakes will be useful in evaluating the long-range water quality trends in Lake Michigan. This data should be entered into the FWPCA data bank. Analytical methods and reporting procedures should be consistent with those established by the proposed State and Federal Laboratory Directors Committee. Since it is anticipated that the water plant laboratory directors will be responsible for some of the analysis, they should be invited as participants to the Laboratory Directors Committee.

TABLE 6

CURRENT ANALYTICAL METHODS IN USE BY THE STATES AND FWPCA

Parameter	Wisconsin	Illinois	Indiana	Michigan	L. Michigan Basin Office	Remarks
Acidity	Vol. Elect. Endpoint	A pp 46-47	Vol. Elect. Endpoint	Vol. Elect. Endpoint	A pp 46-47	Results should agree.
Alkalinity	Vol. Elect. Endpoint	A pp 48-52 Methyl purple 4.8	Vol. Elect. Endpoint	A pp 48-52 Methyl red 4.5	A pp 46-47 pH 4.6	Results may not agree.
Aluminum	A pp 53-56	A pp 53-56	Colorimetric Sandell 1944	AA	AA	Results should agree.
Arsenic	A pp 56-57	A pp 56-57	A pp 56-57	A pp 56-57	A pp 56-57	Results should agree.
Ash	A pp 244-245	Not done.	A pp 244-245	A pp 244-245	A pp 244-245	Results should agree.
BOD	A pp 415-421 DO probe	A pp 415-421 Modified	A pp 415-421	A pp 415-421 Polarographically	A pp 415-421 DO probe	Results should agree.
Cadmium	AA	AA	AA	Dithizone	AA	Dithizone method not consistent with AA.
Calcium	EDTA	AA	EDTA	EDTA	EDTA	Results should agree.
COD	A pp 510-514	Auto Analyzer	A pp 510-514	A pp 510-514	A pp 510-514	Results should agree.

A - Standard Methods 12th Edition, 1965 AA - Atomic Absorption
EDTA - Disodium Ethylenediamine Tetraacetate Dihydrate

TABLE 6 (Continued)

CURRENT ANALYTICAL METHODS IN USE BY THE STATES AND FWPCA

Parameter	Wisconsin	Illinois	Indiana	Michigan	L. Michigan Basin Office	Remarks
Chloride	A pp 86-87 (Mohr)	A pp 87-90 $Hg(NO_3)_2$	$AgNO_3$ Potentiometric Titration	A pp 86-87 (Mohr)	Auto Analyzer $Hg(SCN)_2$ & Fe $NH_4(SO_4)_2$	Results will not be in agreement - wide differences.
Chlorinated Hydrocarbons	G. C. FWPCA	Modified FWPCA Varian Aerograph	FWPCA	FWPCA	FWPCA	Results should agree.
Chlorine Demand	A pp 112-114	A pp 112-114 Modified	A pp 112-114	A pp 112-114	A pp 112-114	Results should agree.
Chlorine Residual	A pp 376-378 & A pp 379	A pp 376-378 & A pp 379	A pp 379	A pp 376-378	A pp 376-378 & A pp 379	Results should agree.
Chromium	A pp 478 & AA	AA	A pp 478	A pp 478	AA	Results should agree.
Color	A pp 127-129 & disks	A pp 127-129 Spect.	A pp 127-129	A pp 127-129 Spect.	Hellige Aqua Tester Disks	Results may not agree.
Conductivity	A pp 280-284	A pp 280-284	A pp 280-284	A pp 280-284	A pp 280-284	Results should agree.
Copper	AA & A pp 479-482	AA	AA	Diethyl-dithio carbamate modified with polyphospate	AA	Michigan may not agree.
Cyanide	A pp 450-457 boric acid distillation	A pp 450-457 modified	A pp 450-457 modified	A pp 450-457 modified	A pp 450-457 modified	Wisconsin may not agree.

A - Standard Methods 12th Edition, 1965   AA - Atomic Absorption

TABLE 6 (Continued)

CURRENT ANALYTICAL METHODS IN USE BY THE STATES AND FWPCA

Parameter	Wisconsin	Illinois	Indiana	Michigan	L. Michigan Basin Office	Remarks
DO	Probe	A pp 406-410	A pp 406-410	A pp 406-410	A pp 406-410 Probe	Results should agree.
Fluoride	A pp 144-146	A pp 144-146 or probe	A pp 141-142 Alizarin Visual	A pp 144-146 not distilled	A pp 144-146	Results may not agree.
Hardness-Calcium	EDTA	EDTA or AA	EDTA	EDTA	EDTA	Results should agree.
Hardness-Mg.	EDTA	EDTA or AA	EDTA	EDTA	Auto Analyzer - Mg. Blue	Results should agree.
Hardness-Total	EDTA	EDTA	EDTA	EDTA	EDTA	Results should agree.
Iron	AA & A	AA	A pp 159-161 Tripyridine	Thio cyanate	AA	Results may not agree.
Lead	AA	AA	AA	Dithizone	AA	Results may not agree.
Magnesium	AA & A	AA	EDTA	EDTA	Auto-Analyzer-Mg Blue	Results should agree.
Manganese	AA	AA	AA	Persulfate method A pp 173-174	AA	Michigan may not agree.

A - Standard Methods 12th Edition, 1965 AA - Atomic Absorption
EDTA - Disodium Ethylenediamine Tetraacetate Dihydrate

TABLE 6 (Continued)

CURRENT ANALYTICAL METHODS IN USE BY THE STATES AND FWPCA

Parameter	Wisconsin	Illinois	Indiana	Michigan	L. Michigan Basin Office	Remarks
MBAS	A pp 297-299 modified	Auto Analyzer-Methylene Blue	A pp 297-299 modified	Taluidine Blue	Auto Analyzer - Methylene Blue	Results may not agree.
NH_3-N	A pp 187-193 modified	A pp 187-193 modified	Direct Nesslerization	Phenate Cal.	Auto Analyzer - Phenate	Results should agree.
T. Kj-N	A pp 403-404 modified	Not run on surface waters.	A pp 403-404 modified	A pp 403-404 modified	A pp 403-404 modified	Results should agree.
NO_3-N	A pp 195-198 Phenol disulphonic	A pp 195-198 or Auto Analyzer method.	A pp 198-200 Brucine	A pp 198-200 No sulfanilic acid.	Auto Analyzer method.	Results may not agree.
NO_2-N	A pp 205-208 modified	A pp 205-208 modified	A pp 205-208 modified	Not run.	Auto Analyzer A pp 205-208	Results should agree.
Odor	Not run	A pp 304-311 modified	A pp 304-311 modified	A pp 304-311 modified	Not run.	Will not agree - personal element too influencing.
Oil and Grease	A pp 383-385	A pp 211-213 ($CHCl_3$) A pp 383-385 modified	A pp 383-385 A pp 211-213	A pp 383-385	A pp 383-385 A pp 211-213	Results may not agree.
pH	A pp 226-228	A pp 226-228	A pp 226-228	A pp 226-228	A pp 226-228	Results should agree.

A - Standard Methods 12th Edition, 1965   AA - Atomic Absorption

TABLE 6 (Continued)

CURRENT ANALYTICAL METHODS IN USE BY THE STATES AND FWPCA

Parameter	Wisconsin	Illinois	Indiana	Michigan	L. Michigan Basin Office	Remarks
Phenolics	A- 11th Ed.	A pp 514-521 Auto Analyzer	A pp 514-521	4-AAP Gibbs modified arsenite catalyst	A pp 514-521 NaOH preservative pH 11.0	Results should agree.
Sol. -Phos	Not run.	Sn Cl$_2$ - filtered	Sn Cl$_2$ - filtered	Sn Cl$_2$ - filtered	PAT - filtered	Results may not agree.
Total Phos	Sn Cl$_2$ ashed MGNO$_3$	Sn Cl$_2$	Sn Cl$_2$	Sn Cl$_2$, Persulfate	PAT	Results may not agree.
Sol. Orth - P	Not run.	Sn Cl$_2$ - filtered	Sn Cl$_2$ - filtered	Sn Cl$_2$ - filtered	Not run.	Not run by two laboratories.
T. Ortho - P	Sn Cl$_2$	Sn Cl$_2$	Sn Cl$_2$	Sn Cl$_2$	Not run.	Not run by one laboratory.
K	AA	AA	Flame emission.	Flame emission.	Flame emission.	Results should agree.
Gross Alpha and Beta	As recommended 336-342	IPC modified 336-342	As recommended 336-342	As recommended 336-342	As recommended 336-342.	Results should agree.
Ra 226 sol. susp. & T.	Not run.	Not run.	Not run.	As recommended	Not run.	Only run by one laboratory.
Se	Not run.	Not run.	Not run.	A pp 251-253	Not run.	Only run by one laboratory.

A - Standard Methods 12th Edition, 1965   AA - Atomic Absorption
PAT - Potassium Antimonyl Tartrate

TABLE 6 (Continued)

CURRENT ANALYTICAL METHODS IN USE BY THE STATES AND FWPCA

Parameter	Wisconsin	Illinois	Indiana	Michigan	L. Michigan Basin Office	Remarks
Si O_2	Not run.	Gravimetric or Col. A pp 258-264	Not run.	AA	A pp 264-265 Hetro poly blue Auto Analyzer	Results may not agree.
Na	AA	AA	Flame emission.	Flame emission.	Flame emission.	Results should agree.
Dis. Solids	A pp 245-246 fiberglas	A pp 280-284 Calc. from cond.	A pp 245-246 membrane	A pp 245-246 fiberglas	A pp 245-246 fiberglas	Illinois results may not agree.
Susp. Solids	A pp 246-247 fiberglas	Not run.	A pp 246-247 membrane	A pp 246-247 fiberglas	A pp 246-247 fiberglas	Results should agree.
T. Solids	A pp 244-245	A pp 423	A pp 244-245	A pp 244-245	A pp 244-245	Illinois results may not agree.
Vol. Suspended Solids	A pp 247-248	A pp 423	A pp 247-248	A pp 247-248 ignited for 10 min.	A pp 247-248	Michigan results may not agree.
SO_4	A pp 291-293	Ill. method	A pp 291-293	A pp 291-293	Auto Analyzer Sulfa Ver (Hach)	Results should agree except for Illinois.
Temp.	A	Mercury	A	A	Dial calibrated vs Mercury	Results should agree.
Turbidity	Hach model 1860 & Candle	Candle & Hellige	Candle	Hellige & Candle	Hellige	Results may not agree.

A - Standard Methods 12th Edition, 1965 AA - Atomic Absorption

TABLE 6 (Continued)

CURRENT ANALYTICAL METHODS IN USE BY THE STATES AND FWPCA

Parameter	Wisconsin	Illinois	Indiana	Michigan	L. Michigan Basin Office	Remarks
Zn	AA	AA	AA	Zincon A pp 320-321	AA	Results should agree except for Michigan.

A - Standard Methods 12th Edition, 1965   AA - Atomic Absorption

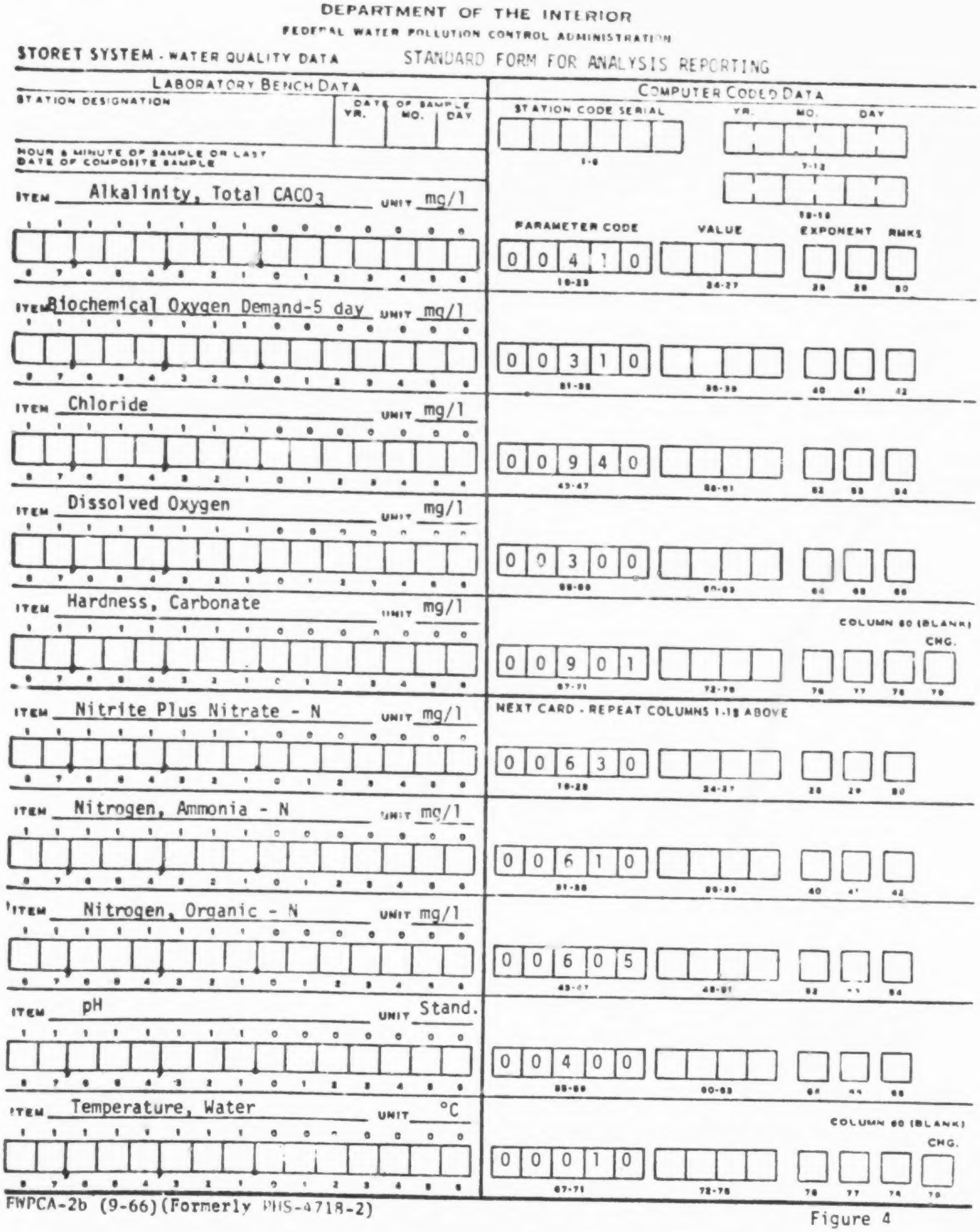
Chapter VIII

ANALYSIS REPORTING

At present each of the States and the Federal Water Pollution Control Administration tabulates results of its monitoring programs and makes the data available to interested parties. Samples will be collected from tributaries, open waters, water filtration plants, and for the Thermal and Nuclear and Pesticides Committees needs. Since this information should be made available to all parties, it would benefit all agencies if one agency had the responsibility of tabulating the sampling data.

The Department of the Interior has a central computer system which is capable of storing and analyzing data on water quality. The computer can perform calculations and present the data in almost any form desired.

The Monitoring Committee proposes that information from Lake Michigan sampling be transmitted to the Federal Water Pollution Control Administration, Lake Michigan Basin Office, for inclusion into the computer. The data should be transmitted monthly on a standard form to facilitate processing. A suggested form is shown as Figure 4. Flow data should be transmitted as it becomes available. The State and Federal data should then be made available semi-annually by the FWPCA to each of the participating agencies. Each State water pollution control agency and the FWPCA should evaluate and interpret data collected by that agency in relation to water quality standards, recommendations of the Lake Michigan Enforcement Conference and long-term trends, and present results of such evaluation and interpretation at each future progress meeting of the Conferees. The data should also be periodically evaluated for adequacy of each station location, parameters analyzed and sampling frequency.



DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

STORET SYSTEM - WATER QUALITY DATA STANDARD FORM FOR ANALYSIS REPORTING

LABORATORY BENCH DATA

STATION DESIGNATION

DATE OF SAMPLE YR. MO. DAY

HOUR & MINUTE OF SAMPLE OR LAST DATE OF COMPOSITE SAMPLE

COMPUTER CODED DATA

STATION CODE SERIAL ☐☐☐☐☐☐ 1-6

YR. MO. DAY ☐☐☐☐☐☐ 7-12

☐☐☐☐☐☐ 13-18

Item	Unit	Parameter code	Value	Exponent	Rmks
Alkalinity, Total $CACO_3$	mg/1	0 0 4 1 0 (19-23)	☐☐☐☐ (24-27)	☐ 28	☐ 29 ☐ 30
Biochemical Oxygen Demand-5 day	mg/1	0 0 3 1 0 (31-35)	☐☐☐☐ (36-39)	☐ 40	☐ 41 ☐ 42
Chloride	mg/1	0 0 9 4 0 (43-47)	☐☐☐☐ (48-51)	☐ 52	☐ 53 ☐ 54
Dissolved Oxygen	mg/1	0 0 3 0 0 (55-59)	☐☐☐☐ (60-63)	☐ 64	☐ 65 ☐ 66
Hardness, Carbonate	mg/1	0 0 9 0 1 (67-71)	☐☐☐☐ (72-75)	☐ 76	☐ 77 ☐ 78 CHG. ☐ 79

COLUMN 80 (BLANK)

NEXT CARD - REPEAT COLUMNS 1-18 ABOVE

Item	Unit	Parameter code	Value	Exponent	Rmks
Nitrite Plus Nitrate - N	mg/1	0 0 6 3 0 (19-23)	☐☐☐☐ (24-27)	☐ 28	☐ 29 ☐ 30
Nitrogen, Ammonia - N	mg/1	0 0 6 1 0 (31-35)	☐☐☐☐ (36-39)	☐ 40	☐ 41 ☐ 42
Nitrogen, Organic - N	mg/1	0 0 6 0 5 (43-47)	☐☐☐☐ (48-51)	☐ 52	☐ 53 ☐ 54
pH	Stand.	0 0 4 0 0 (55-59)	☐☐☐☐ (60-63)	☐ 64	☐ 65 ☐ 66
Temperature, Water	°C	0 0 0 1 0 (67-71)	☐☐☐☐ (72-75)	☐ 76	☐ 77 ☐ 78 CHG. ☐ 79

COLUMN 80 (BLANK)

Under each Item line, 15 boxes are marked above: 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0, and below: 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6

FWPCA-2b (9-66)(Formerly PHS-4718-2)

Figure 4

C. Pemberton, Jr.

Appendix

SIGNIFICANCE OF ANALYTICAL DETERMINATIONS

Parameters considered of significance in the tributary and open water sampling of Lake Michigan have been tabulated in Table 2 and on pages 815 and 816. The definitions and significance of these parameters as summarized from available information are listed below.

ALKALINITY

Alkalinity is the capacity of a water to neutralize hydrogen ions and is expressed in terms of an equivalent amount of calcium carbonate. Alkalinity affects the treatment required for waters at water treatment plants when the water is used for industrial or domestic purposes.

AMMONIA, NITROGEN

Ammonia results from the decomposition of nitrogenous organic matter. Ammonia,under specific conditions, is toxic to many forms of aquatic life and is an added burden to water treatment and to disinfection of sewage plant effluent because of its high chlorine demand. Its presence in water is an indicator of fresh sewage pollution of domestic origin. It can also be discharged from chemical or gas plants, ice plants, or plants using "ammonia water" for scouring and cleaning operations.

BIO-CHEMICAL OXYGEN DEMAND (BOD)

The introduction of organic waste into water--whether the waste originates from domestic sewage, industrial processes, land runoff--results in a reaction involving organic material, micro-organisms and the natural biota present in the receiving water. Organic matter is utilized as food by the organisms with the accompanying consumption of oxygen. The BOD test is a means of measuring the amount of unstable organic matter in water.

CADMIUM

Cadmium is a metal found rarely in natural water and is generally an indication of industrial pollution. It is toxic to man when ingested and is toxic to aquatic life including fish. It is used in electroplating, photography, ceramics, pigmentation and nuclear reactors.

CALCIUM

Calcium is an alkaline metal which

produces hardness in water. Many industrial water uses require waters with very low calcium content. It is also an important element in the growth of algae and plankton.

CHLORIDE

Although chlorides are present to some extent in most surface waters, they are also associated with man's activities since the chloride anion is a component of human waste and is widely used in many industrial processes. Chlorides can impart a salty taste to drinking water and render it unpalatable. Chlorides are not removable by conventional water and waste treatment methods. An increase in chloride concentration would imply deterioration in water quality. Chloride is a good indicator parameter because it does not deteriorate. In fresh water it may indicate the presence of animal pollution and industrial and agricultural wastes.

CHROMIUM

Chromium is a heavy metal and is toxic to man and aquatic life when present in either the hexavalent or trivalent form. It is used in metal pickling and plating operations, in anodizing alumium, in leather industry as a tanning agent, and in the manufacture of paints, dyes, explosives, ceramics and paper. Its presence in water is indication of industrial pollution.

COLOR

Colored water is an indication of either suspended matter or dissolved matter. Color can be natural or indicative of harmful wastes in the water, capable of impairing the aesthetic value.

CONDUCTIVITY

Conductivity is a measure of the water's capacity to conduct a current of electricity. Conductivity changes in proportion to the quantity of dissolved minerals in the waters. Changes in dissolved mineral content of water could be caused by natural conditions or pollution.

COPPER

Copper occurs in natural waters only in trace amounts. Excessive quantities are generally attributable to industrial wastes or to the use of copper for the control of undesirable plankton organisms. Copper in water is detrimental for some industrial uses and has been found toxic to aquatic organisms including bacteria and fish.

CYANIDE

Cyanides are very toxic even at low concentrations and may occur in the effluents from gas works and coke ovens, from scrubbing of gases at steel plants, from metal cleaning and electroplating processes and from chemical industries. Its presence in water is an indication of industrial waste.

DISSOLVED OXYGEN

Dissolved oxygen is one of the most important indications of the condition of water. It is necessary for the existence, propagation and migration of aquatic life. The knowledge of the oxygen content is essential for the study of pollution effects on the receiving waters. It is also of significance in evaluating corrosiveness of water.

FLUORIDE

Fluorides are commonly used in drinking water to decrease the incidence of tooth decay; higher concentrations cause mottling of the teeth. An abnormal fluctuation of the fluoride content in water is usually an indication of industrial wastes. It is used for preserving wood and mucilages, for the manufacture of glass and enamels, in chemical industries, and as a flux in the manufacture of steel and aluminum.

HARDNESS

Hardness is a characteristic which determines the usefulness and economic value of water for many purposes. Hard water forms scale in boilers, heaters, radiators and pipes and adversely affects the flow and heat transfer and accelerates boiler failure. Hard water used for domestic purposes results in a higher consumption of soap and detergents.

IRON AND MANGANESE

Iron and manganese at small concentrations are capable of staining laundry, porcelain and fixtures; when waters containing iron and manganese are exposed to the air, the water becomes turbid and unacceptable from an aesthetic viewpoint. Both iron and manganese interfere with laundry operation. Iron causes difficulty in water distribution systems by supporting growths of iron bacteria.

LEAD

Lead occurs in natural waters only in

trace amounts. Excessive quantities are generally attributable to the action of water on lead pipe and industrial wastes. Lead is toxic to man in low concentrations and is accumulative in body tissue. It is also toxic to aquatic life, including fish.

MAGNESIUM

Magnesium, like calcium, is a hardness-producing mineral and contributes to the problems of scaling and reduced heat transfer in heating and cooling systems. Magnesium is used in the manufacture of electrical and optical apparatus and as a constituent of light alloys.

METHYLENE BLUE ACTIVE SUBSTANCES (MBAS)

Methylene Blue Active Substances are anionic surface-active agents which are a common ingredient of many commercial synthetic detergents. Their function in the detergent is to impart foam and reduce surface tension to aid in the removal of dirt particles. MBAS is toxic to fish, causes undesirable tastes, and produces unsightly persistent foams.

NICKEL

Nickel occurs in natural waters only in

trace amounts. It is toxic to aquatic life and harmful to plant life when present in irrigation water. Nickel is used in metal plating works. Its presence in water is usually an indication of industrial wastes.

NITRATE-NITRITE NITROGEN

Nitrates are the end product of aerobic stabilization of organic nitrogen and occur in polluted waters that have undergone nitrification. Nitrites occur as an intermediate stage of nitrification. Wastes from sewage treatment plants, chemical fertilizer producing plants, and land drainage are major sources of nitrate pollution. Nitrates are considered one of the key nutrients which contribute to algae blooms.

OIL - GREASE

The presence of oil and grease in water is aesthetically objectionable and may impart taste and odor to drinking water. Possible contributors to oil pollution are all industries engaged in production, transportation, handling or use of oils.

pH

Hydrogen ion concentration is an indicator as to whether water is acid, neutral or alkaline. Acidic waters disrupt biological activity, cause corrosion of steel and concrete, intensify the effect of toxic materials such as sulfides and cyanides, and interfere with water plant coagulation practices. Alkaline waters also disrupt biological activity, precipitate iron, calcium and magnesium and increase the toxicity of ammonia and amines.

PHENOLIC COMPOUNDS

Phenolic material, when found in water is usually the result of pollution by industrial wastes. Phenols are widely used in the synthesis of many organic compounds. Waste products from oil refineries, coke ovens, and chemical plants may contain high concentrations. Very low concentrations of phenols will impart a disagreeable taste to water when chlorinated.

PHOSPHORUS

Phosphorus, like the nitrogen compounds, is a necessary nutrient for biological activity and algal blooms. Phosphorus enters the water environment in treated sewage since it is normally present in human and animal waste products. Synthetic detergents contain high concentrations of phosphorus. Phosphorus is also present in surface runoff, particularly from fertilized fields.

PHYTOPLANKTON

Plant micro-organisms, such as certain algae, living unattached in the water. This suspended microscopic plant life is only slightly motile and exists at or near neutral buoyancy. As such they are subject to lake currents and represent the microflora of the sampling site at the time of sampling.

RADIATION

Gross Alpha and Gross Beta. By establishing background levels of alpha and beta radiation in waters, any abnormal deviations will be indicative of pollution from industrial sources, such as nuclear power plants, or of fallout. A high concentration of beta radioactivity is an indication of the need for further investigation to prevent the ingestion of or external exposure to dangerous amounts of specific radioisotopes.

SODIUM AND POTASSIUM

Sodium and potassium are usually found in low concentrations in natural waters. Sodium has a degrading effect on soil used for agricultural purposes. Potassium is used in fertilizers and some varieties of glass. Sodium is a very active metal that does not occur free in nature. They are important elements to the growth of algae.

SOLIDS, DISSOLVED

Dissolved solids are both organic and inorganic matter, which when excessive render drinking water unpalatable and increases cost of water treatment for many other uses. The presence of dissolved solids may be an indication of industrial wastes.

SOLIDS, SUSPENDED

In natural waters, suspended solids consist normally of eroded silt, organic detritus and plankton. Suspended solids in the stream are all considered to be settleable solids since time is not a limiting factor. Suspended solids impart turbidity to the water and may interfere with many industrial processes.

SOLIDS, VOLATILE SUSPENDED

Volatile suspended solids is a measure of the organic or oxygen-consuming matter in the suspended solids.

SILICA

The element silicon is not found free in nature but occurs as silica in sand or quartz and as silicates in feldspar, kaolinite, and other minerals. Silicon dioxide, or silica, is insoluble in water or acids, except hydrofluoric, but it may occur in natural waters as finely divided colloidal suspended matter. Silicon is used in metallurgy and silica is widely employed in industry for making glass, silicates, ceramics, abrasives, enamels and petroleum products. Silicates have been used in water treatment as coagulants and corrosion inhibitors while sodium silicofluoride has been used as a fluoridating agent. Silicon is an important nutrient for some biota.

SULFATES

Sulfate is a component of the dissolved ionic solids present in most surface waters. Sulfates in combination with sodium or magnesium can produce a laxative effect. Sulfates may be discharged from tanneries, textile mills, and sulfate pulp mills.

TEMPERATURE

Temperature affects the biological and

sanitary characteristics of a body of water. Water at a higher temperature has a lower capacity for oxygen than water at a lower temperature. Temperature differentials also determine the vertical mixing characteristics of a large lake. Variations in the temperature of the water can be caused by waste discharges or natural seasonal or air fluctuations of the temperature.

TOTAL PLATE COUNTS

Total plate counts are approximate enumerations of total bacteria multiplying at temperatures of 35°C. or 20°C. on any one of several nutrient agars. They yield useful information concerning the quality of water tested and the total bacterial densities in water correspond to the decomposition of organic matter. Total plate counts are used in lieu of the coliform test because past experience indicates that coliform counts usually are too low to be measurable in the open waters of Lake Michigan.

TURBIDITY

Turbidity is attributable to suspended and colloidal matter which diminish penetration of light. The turbidity of waters for domestic use is an indicator of the degree of treatment necessary.

ZINC

Zinc is present in most natural waters only in trace amounts. It can be toxic to man and aquatic life and its presence is related to industrial wastes or to the corrosive action of water on galvanized piping. Zinc is used in paint pigments, pharmaceuticals, dyes, insecticides, comestics and in numerous other products.

FECAL COLIFORM

Fecal coliform are indicators of recent contamination with feces of warm-blooded animals and may indicate the presence of pathogenic organisms.

TOTAL COLIFORM

The coliform group of organisms includes all aerobic and anaerobic, gram negative, non-spore forming rod shaped bacteria that ferment lactose with gas formation within 48 hours. It includes Escherichia coli strains which are usually of fecal origin and intermediate and Aerobacter aerogenes strains which are usually of soil, vegetable or other non-fecal origin.

ZOOPLANKTON

Animal micro-organisms living unattached in water. They include small crustacea, such as daphnia and cyclops, and single-celled animals as protozoa, etc. These suspended microscopic animal life are only slightly motile and exist at or near neutral buoyancy. As such they are subject to lake currents and represent the microfauna of the sampling site at the time of sampling.

- - -

MR. STEIN: Any questions or comments?

If not, thank you very much, sir, for a very complete report.

MR. PURDY: Mr. Stein, one question.

MR. STEIN: Yes.

MR. PURDY: Carlysle, on No. 11, this is the one on the special studies, where routine investigations indicated the need for additional studies, did the Committee have a recommendation on who would determine the need? I mean how was this determined?

MR. PEMBERTON: I would say that we recommended that each agency evaluate the data that it collects and, therefore, I think the agency would be in a position to determine that need.

MR. PURDY: O. K.

MR. STEIN: Thank you, Mr. Pemberton.

MR. POSTON: Mr. Pemberton, you have a contingency plan report. Could we enter that in the record without a summary being given at this time?

MR. PEMBERTON: Yes, if you like.

MR. POSTON: To save time, this might be helpful.

MR. STEIN: If there is no objection, that will be done.

MR. PEMBERTON: In connection with my contingency plan report, I was going to ask that the National Multiagency Oil and Hazardous Materials Contingency Plan be entered in the record of this Conference, if you don't mind.

MR. POSTON: Very good.

MR. STEIN: Without objection, that will be done.

(The following are the documents submitted by Mr. Pemberton:)

CONTINGENCY PLAN FOR POLLUTIONAL SPILLS IN THE GREAT LAKES REGION

CONFERENCE IN THE MATTER OF POLLUTION OF LAKE MICHIGAN AND TRIBUTARY BASIN - SECOND SESSION

FEBRUARY 25, 1969

People throughout the world became aware of the destructive characteristics of oil spilled in the environment, and the inadequacy of current measures for dealing with a major spill when the Torrey Canyon ran aground and broke up off the coast of England in March of 1967. On May 26, 1967, the President of the United States directed the Secretaries of the Interior and Transportation to undertake a joint study to determine how the resources of the Nation could best be mobilized to counteract the pollutional effects of spills of oil and other hazardous materials in our waterways. One of the major needs disclosed by the study was for the development of a contingency plan to deal with emergencies involving Federal, State and local agencies with due regard for each agency's statutory responsibility and capability. On June 7, 1968, the President directed the Secretaries of the Interior, Defense, and Transportation and the Director of the Office of Science and Technology to assume special responsibilities in strengthening our preparedness to act in the event of a major oil spill. The Secretary of the Interior was directed to assume primary responsibility for completing by July 31, 1968, a draft National Multiagency Contingency Plan for responding to major pollutional spills. The National Plan was approved by the President on November 13, 1968. At this time I ask that the National Multiagency Oil and Hazardous Materials Contingency Plan be entered in the record.

The National Plan provides guidelines for the establishment of regional contingency plans. Regional offices of the FWPCA have developed framework regional contingency plans and are now expanding these plans in accordance with provisions of the National Plan. Copies of the framework plan for the Great Lakes Region were distributed to State water pollution control agencies for their review and comment in August 1968. We have received comments from only one State in the Lake Michigan Basin.

The purpose of the Regional Contingency Plan is to present guidelines to minimize the pollutional effects of a major spill of oil or other hazardous materials within the Great Lakes Region.

The objectives of this plan are to develop effective systems for discovering and reporting the existence of a pollution incident, promptly instituting measures to restrict the further spread of the pollutant, application of techniques to cleanup and disposal of the collected pollutants, and institution of action to recover cleanup costs and effect enforcement of existing statutes.

The Regional Plan includes a Federal regional reaction team called the Regional Operations Team (ROT) and a Regional Operations Center (ROC). The ROT consists of a representative from each of the signatory agencies to the National Plan. The Federal Water Pollution Control Administration, Coast Guard, Army Corps of Engineers, Public Health Service, and Office of Emergency Preparedness have representatives on the Regional Operations Team. In accordance with the National Plan, the Regional Operations Center is the regional site for activities relative to pollution incident situations. The ROC will be activated at either the Ninth Coast Guard District Office in Cleveland or the Second Coast Guard District Office in St. Louis, depending upon the location and circumstances of a spill.

Coordination and direction of Federal pollution control efforts at the scene of a pollution incident shall be accomplished through an On-Scene Commander (OSC). The On-Scene Commander (OSC) is the single executive agent predesignated by the Regional Plan to coordinate and direct such Federal pollution control efforts. The Coast Guard Captains of the Port are the On-Scene Commanders for the Great Lakes and inland navigable waterways. The Department of the Interior furnishes or provides for OSC's in other areas within the Great Lakes Region.

Recommendation 16 contained in the summary of the first session of this Conference called for the State water pollution control agencies and the U.S.

Department of the Interior to compile an inventory of all sites where potential exists for major spills of oil and other hazardous material. The inventory of potential sources of pollution will be continually updated by the FWPCA with the assistance of the States. In addition, FWPCA is developing an inventory of resources which may be useful in combating spills.

To be more effective in combating the pollutional effects of a major spill, further coordination among the various levels of government is needed and will be sought by FWPCA in the coming months.

The Great Lakes Regional Contingency Plan encourages the development of State and local government capabilities and private capabilities to handle major pollution incidents.

The response efforts of the various levels of government must be fully coordinated to achieve the most effective pattern of response. To accomplish both the development of capabilities and coordination of responses, State and local agencies are invited to participate in the regional planning necessary to accomplish the objectives of this Plan.

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NATIONAL MULTIAGENCY
OIL AND HAZARDOUS MATERIALS
CONTINGENCY PLAN

SEPTEMBER 1968

NATIONAL MULTIAGENCY OIL AND HAZARDOUS MATERIALS POLLUTION CONTINGENCY PLAN

This National Multiagency Contingency Plan, prepared at the direction of President Lyndon B. Johnson, provides a mechanism for coordinating the Federal response to a spill of oil or other hazardous materials. Agencies signatory to this Plan are:

Department of the Interior

Department of Transportation

Department of Defense

Department of Health, Education, and Welfare

Office of Emergency Planning

September 1968

C. Pemberton, Jr.

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Abbreviations and Definitions

Department and Agency Title Abbreviations:

DHEW - Department of Health, Education, and Welfare

DOD - Department of Defense

DOI - Department of the Interior

DOT - Department of Transportation

OEP - Office of Emergency Planning

FWPCA - Federal Water Pollution Control Administration

USCG - U. S. Coast Guard

USPHS - U. S. Public Health Service

Operation Title Abbreviations

JOC - Joint Operations Center

JOT - Joint Operations Team

NIC - National Interagency Committee for Control of Pollution by Oil and Hazardous Materials

OSC - On-Scene Commander

ROC - Regional Operations Center

ROT - Regional Operations Team

Definitions

Pollution Incident - is a discharge of oil or other hazardous substance of such magnitude or significance as to require immediate response to contain, clean up or dispose of the material to prevent a substantial threat to public health or welfare.

Major Disaster - is any flood, drought, fire, hurricane, earthquake, storm or other catastrophe in any part of the United States, which, in the determination of the President, is or threatens to become of sufficient severity and magnitude to warrant disaster assistance by the Federal Government to supplement the effort and available resources of States and local governments in alleviating damage, hardship or suffering.

Oil - is any kind or form of oil including but not limited to fuel oil, sludge oil refuse and oil mixed with wastes other than dredged spoil.

Hazardous Substance - is matter of any description or origin other than oil, which when discharged into any waters in substantial quantities, presents an imminent and substantial hazard to the public health or welfare, including fish, shellfish, and wildlife and shorelines and beaches.

NATIONAL MULTIAGENCY OIL AND HAZARDOUS MATERIALS POLLUTION CONTINGENCY PLAN

Introduction

The development of a National awareness and concern over the hazards and damages to water related resources from oil pollution can be traced in large part to the sinking of the tanker, TORREY CANYON. This marine casualty off the south coast of England, caused a massive oil spill with a tragic destruction of water related resources along both the English and French coasts. But more importantly, it galvanized the United States into action and caused us to assess our own capabilities to cope with massive spills of oil or other hazardous substances. President Johnson recognized this need by directing the Secretary of the Interior and the Secretary of Transportation to study the Nation's capabilities for handling such disasters. The results of this study are detailed in "Oil Pollution - A Report to the President." This report documented our unpreparedness to deal with a catastrophic oil spill, and clearly pointed to many areas of needed Federal action.

On June 7, 1968, the President, by memorandum, directed the Secretaries of Defense, Interior and Transportation and the Director of the Office of Science and Technology to assume special responsibilities in order to strengthen this Nation's preparedness to act in the event of an oil spill pollution emergency along our coasts and waterways. The President further directed the Secretary of the Interior to assume primary responsibility for completing, at the earliest possible date, multi-agency contingency plans for responding to oil spill emergencies. This document is directed toward fulfilling the President's directive.

Purpose and Objectives

This plan represents an agreement among concerned Departments and agencies of the Federal Government for a pattern of coordinated and integrated responses to pollution incidents. It establishes a National reaction team and provides guidelines for the establishment of regional contingency plans and reaction teams. This plan promotes the coordination and direction of Federal, State and local response systems and encourages the development of local government and private capabilities to handle such pollution incidents.

The objectives of this plan are to develop effective systems for discovering and reporting the existence of a pollution incident, promptly instituting measures to restrict the further spread of the pollutant, application of techniques to clean up and dispose of the collected pollutants, and institution of action to recover cleanup costs and effect enforcement of existing Federal statutes. Regional contingency plans will provide further detailed guidance toward the accomplishment of these objectives.

C. Pemberton, Jr.

Scope

This plan will be effective for all United States navigable waters including inland rivers, Great Lakes, coastal territorial waters, and the contiguous zone and high seas beyond this zone where there exists a threat to United States waters, shoreface, or shelf-bottom.

The provisions of this National Multiagency Oil and Hazardous Materials Pollution Contingency Plan are applicable to all Federal agencies signatory thereto. Implementation of this plan will be compatible and complementary to currently effective assistance plans, agreements, security regulations, and responsibilities based upon Federal statutes and executive orders (see Annex #3).

Policy on Federal Response to Pollution Incidents

The Federal policy to prevent, control and abate water pollution has been established by statute, for the purpose of protecting and enhancing the quality and value of our Nation's water resources. To this end, the discharge of oil under certain conditions is prescribed and the discharge of oil from any boat or vessel into the navigable waters of the United States prohibited; the Secretary of the Interior may accomplish the removal of such discharged oil if the person responsible fails to remove it from the navigable waters and adjoining shorelines; oil, classified as a refuse, may not be discharged; and oil may not be discharged from vessels in international waters near the shores of the United States. Additionally, the President has established the policy that appropriate Federal resources will be used for dealing with the pollution aspects of oil spill problems and to protect our natural resources from their consequences.

In the event that the person responsible for a pollution incident does not act promptly, does not take or propose to take actions to contain, clean up and dispose of pollutants which are concurred in by the DOI representative or ROT, or the discharger is unknown, further Federal response actions may be instituted. A primary thrust of regional plans is to encourage the person responsible for the discharge of oil or other hazardous substances causing the pollution incident to remove the pollutant or adequately mitigate its effects.

When such person is taking adequate action, the principal thrust of Federal activities shall be to observe and monitor progress and to provide advice and counsel as may be necessary.

The Federal agencies signatory to this plan possessing facilities or other resources which may be useful in a Federal response situation will make such facilities or resources available for use in accordance with this plan as supplemented by the regional plans. Agencies making resources available to OSC or through JOC shall make such assignment consistent with operational requirements, within the limits of existing statutory authority and without reimbursement, except where reimbursement is specifically required by statute or by agreement with another agency.

Responsibilities

Each of the agencies signatory to this plan has responsibilities established by statute, Executive Order or Presidential Directive, which may bear on the Federal response to a pollution incident. This plan does not intend to delegate any of these responsibilities but intends to promote the expeditious and harmonious discharge of these responsibilities through the assignment of authority for action to those agencies having the most appropriate capability to act in each specific situation. Responsibilities and authorities of these several agencies relevant to the control of pollution incidents are detailed in Annex 3.

Within the framework of this plan, each agency also accepts certain responsibilities to promote the effective operation of the plan. These considerations are spelled out in greater detail in the regional plans. For each agency these are:

The Department of the Interior is responsible for administering, developing and revising the National Multiagency Plan for Oil and Hazardous Materials Pollution and for developing and revising the regional plans. In this activity DOI will give full consideration to the recommendations of NIC concerning the interpretation, revision and application of the plan. Through the resources of the Federal Water Pollution Control Administration, DOI will provide technical expertise to JOT and the ROT's relative to water pollution control techniques. The assessment of damage to fish and wildlife resources will be made by the appropriate DOI agency.

The Department of Transportation, through the U. S. Coast Guard, supplies expertise in fields of navigation, port safety, and security, and maritime law enforcement.

The Office of Emergency Planning will maintain an awareness of pollution incidents as they develop. The normal OEP procedures will be followed to evaluate any request for a major disaster declaration received from a State. If the President declares a major disaster under PL 81-875 for the pollution incident, the Director, OEP, will provide coordination and direction of the Federal response in accordance with OEP policies and procedures.

The Department of Defense, consistent with its operational requirements, may provide military assistance in critical pollution incidents and in the maintenance of navigation channels salvage, and removal of navigation obstructions.

The Department of Health, Education, and Welfare is responsible for providing expert advice and assistance in those pollution incidents that constitute an immediate threat to public health.

All of the Federal agencies signatory to this plan are responsible for making resources available to other Federal agencies as described in the plan's policy for Federal response; for providing official representation to NIC, JOT and ROT; for making information available as may be necessary; and, for keeping JOT informed, consistent with National security considerations, of changes in the availability of resources that would affect the operation of this plan.

National Interagency Committee

The National Interagency Committee (NIC) is the principal instrumentality for plans and policies of the Federal multiagency response to pollution incidents. The Committee is composed of representatives of the agencies signatory to this plan. The representative of DOI will serve as chairman of NIC and the representative of DOT will serve as vice-chairman.

NIC will develop procedures to promote the coordinated reaction of all Federal, State, local government and private agencies to pollution incidents, and will make recommendations to DOI concerning the interpretation, revision and application of the national plan. To facilitate the development of such procedures, NIC may request each agency to supply pertinent data and information on its reaction capability and operating procedures.

NIC will review regional contingency plans and make recommendations for improving the effectiveness of such plans. NIC will also coordinate and review reports from JOC and the ROC on the handling of major or unusual pollution incidents for the purpose of analyzing such incidents and recommending needed improvements in the contingency plans.

In considering the National posture for reaction to pollution incidents, the NIC will consider and make appropriate recommendations relating to the training of reaction team personnel, research, development, test and evaluation activities needed to support reaction capabilities, equipment and material stockpiling and other matters as the need arises.

NIC will establish and maintain liaison with the U. S. National Committee for the Prevention of Pollution of the Seas by Oil to promote a consistent

United States posture regarding oil pollution control. Summary reports and other documents of an evaluative nature will be coordinated through NIC.

Joint Operations Center

The Joint Operations Center (JOC) is the Washington, D. C., headquarters site for activities relative to pollution incidents. JOC will be accommodated in quarters described in Annex 5, and will provide communications, information storage and other necessary physical facilities to promote the smooth and adequate functioning of this activity.

The Joint Operations Team (JOT) consists of representatives of the signatory agencies and shall act as an emergency response team to be activated in the event of a pollution incident involving oil or other hazardous material which: (a) exceeds the response capability of the region in which it occurs, (b) transects regional boundaries, or (c) involves National security or major hazard to substantial numbers of persons or Nationally significant amounts of property. A representative of DOI shall be the Chairman and a representative of DOT shall be Executive Secretary of JOT. The

Executive Secretary shall maintain records of the JOT activities along with national and regional plans for pollution emergency responses. When JOT is activated because of a water pollution emergency situation, the Chairman of JOT will assume the role of principal coordinator of JOT activities.

A continual surveillance of incoming reports from the ROC's will be maintained in JOC. Whenever reports which require or appear to require a national reaction are received, the members of JOT will be advised of the receipt of such reports and JOT may be activated on the request of any member.

During pollution incident operations, JOC will act as the focal point for national public information releases and for information transfer between the OSC and the Washington, D. C., headquarters of the agencies concerned, thereby promoting rapid and accurate information transfer and minimizing the radiation of spurious and incomplete information about any given situation. Public information activites are considered in Annex 12.

During a pollution emergency, JOT will

evaluate reports coming from the OSC, requesting additional information as may be indicated. JOT will coordinate the actions of other regions or districts in supplying needed assistance to the OSC. JOT may recommend courses of action for consideration by the OSC but has no operational control of the OSC. On the basis of reports and information about a pollution incident, JOT may request other Federal, State, local government or private agencies (whether or not they are signatory to this document) to consider taking action under whatever authorities they may have to accomplish needed objectives for the purpose of pollution control. JOT may recommend the deployment of personnel to monitor and observe the handling of any pollution incident. Copies of all reports and documents developed by JOT and ROT as a result of pollution incidents will be provided to NIC for its evaluation.

Regional Operations Center

The Regional Operations Center (ROC) as established by each regional contingency plan, is the regional site for activities relative to pollution incident situations. ROC will be accommodated in physical quarters described in each regional plan and will function at the regional level similarly to JOC. The Regional Operations Team (ROT) will perform functions within the region similar to those performed Nationally by JOT. Additionally, the ROT shall determine when a shift of on-scene coordination from the predesignated OSC to another agency is indicated by the circumstances or progress of a pollution incident. The organization and functions of the ROT are described in each regional contingency plan.

Organization and Functions in Federal Response Situations

Geographic Areas

This contingency plan concerns all of the navigable waters of the United States and areas immediately adjacent thereto, wherein a massive spill of oil or other hazardous substances would directly affect the navigable waters. For the purpose of the development of regional contingency plans the Nation's waters are divided into hydrologically oriented regions corresponding to FWPCA regional outlines. Such regions may be further subdivided into areas by the regional plans if this appears desirable.

On-Scene Coordination

Coordination and direction of Federal pollution control efforts at the scene of a pollution incident shall be accomplished through an On-Scene Commander (OSC). The OSC is the single executive agent predesignated by regional plan to coordinate and direct such pollution control activites in each area of the region.

(a) In the event of a spill of oil or other hazardous substance the first responsible Federal official on the site, from any of the signatory agencies, shall assume coordination of activities under the plan until the predesignated OSC becomes available to take charge of the operation.

(b) The CSC shall initiate and direct Phase II operations and direct Phase III operations as hereinafter described.

(c) The OSC shall determine pertinent facts about a particular incident, such as the nature, amount, and location of material spilled, probable direction and time of travel of the material, resources and installations which may be affected and the priorities for protecting them.

(d) The OSC shall call upon and direct the deployment of needed resources in accordance with the regional plan to initiate and continue containment, countermeasures, cleanup, restoration and disposal functions.

(e) The OSC shall provide necessary support activities and documentation for cost recovery and enforcement functions. (See Annex 11).

(f) In carrying out this plan, the OSC will report to and coordinate closely with ROT to ensure the maximum effectiveness of the Federal effort in protecting the natural resources and environment from pollution damage.

(g) It is recognized that in some

cases the OSC, particularly where he is a Coast Guard Officer, may have other functions such as search and rescue, or fire control and safety which must be performed along with pollution control functions.

The U. S. Coast Guard is assigned the responsibility to furnish or provide for OSC's for the coastal and contiguous zone waters, ports and harbors, Great Lakes and major inland navigable waterways. The Department of the Interior will furnish or provide for OSC's in other areas. A major consideration in the selection of an OSC for a particular area will be that agency's capability and resources for on-scene coordination of pollution control activites. Each OSC and his area of responsibility will be detailed in the regional plans.

Federal Response Operations - Response Phases

The actions taken to combat a pollution incident can be separated into four relatively distinct classes or phases. For descriptive purposes, these are labeled as: Phase I. Discovery and Notifications; Phase II. Containment and Countermeasures; Phase III.

Cleanup, Restoration, and Disposal; and Phase IV. Recovery of Damages and Enforcement. It must be recognized that elements of any one phase may take place concurrently with one or more other phases. The following is a discussion of these phases:

Phase I - Discovery and Notification are the first response actions to a pollution incident. Discovery of an incident may be through deliberate discovery procedures such as vessel patrols, aircraft searches or similar procedures or through random discovery by the incidental observations of government agencies, private agencies or the general public.

In the event of deliberate discovery, the incident would be reported directly to ROC and appropriate action, as detailed in the Regional Plan initiated. Reports from random discovery may be intially made through police departments, telephone operators, port authorities, news media, etc. Regional plans should attempt to channel such reports into ROC as promptly as possible to facilitate prompt reaction.

The severity of the pollution incident will determine the reporting procedure and the specific persons or offices to be notified of the spill. The severity of a spill is determined by the nature and quantity of materials spilled, the location of the spill and the resources adjacent to the spill area which may be affected by it. Regional plans should consider these factors in establishing alerting procedures, however, JOC should be notified immediately in the event of a spill; (a) in the coastal zone of 100,000 or more gallons of heavy oil; (b) in the inland waters of 10,000 or more gallons of heavy oil; or, (c) in any waters of other material of such nature and quantity that human health or welfare is substantially threatened.

Phase II - Containment and Countermeasures are defensive actions to be initiated as soon as possible after discovery and notification of a pollution incident. After the OSC determines that further Federal response actions are needed and depending on the circumstances of a particular incident, they may include the placing of physical barriers to halt or slow the spread of a pollutant, the emplacement or activation of booms or barriers to protect specific installations or areas, increase or reduction of the water discharge from upstream impoundments and the employment of chemicals and other materials to restrain the pollutant and its effects on water related sources.

Phase III - Cleanup, Restoration and Disposal include those actions taken to remove the pollutant from the water such as the collection of oil through the use of sorbents, skimmers or other collection devices, actions taken to restore the environment to its pre-spill condition such as removal and replacement of beach sand or reseeding of a shallfish bed decimated by the toxic effect of a pollutant, and non-polluting disposal of the pollutants which are recovered in the cleanup and restoration activities.

Phase IV - Recovery of Damages and Enforcement may include a variety of activites depending on the location of and circumstances surrounding a particular spill. Recovery of damages done to Federal property under Federal law and to State or local government property under State laws are included; however, third party damage is not considered in this phase. Recovery of the costs of cleanup is a part of this phase and enforcement activities under appropriate jurisdictions such as the Oil Pollution Act of 1924, the Refuse Act of 1899, and State and local statutes and ordinances are also included. The collection of scientific and technical information of value to the scientific community as a basis for research and development activities and for the enhancement of our understanding of the environment may also be considered in this phase. It must be recognized that the collection of samples and necessary data must be performed at the proper time during the pollution incident for enforcement and other purposes.

Procedures to be Followed for the Purpose of Water Pollution Control

The agency furnishing the OSC for a particular area is assigned responsibility to undertake and implement Phase I activities in that area. Other signatory agencies should fold Phase I activities into their on-going programs whenever practicable. Upon receipt of information--either from directed or random discovery activities--that a pollution spill has occurred, the OSC for the affected area and ROT shall be notified. ROT shall consider the facts and may declare that a pollution incident has occurred. Information on the incident shall then be transmitted through the ROC to the OSC, JOC and Federal, State and local agencies in accordance with the Regional Contingency Plan.

The OSC is assigned responsibility for the initiation of Phase II actions. Continuing water pollution control techniques must receive the concurrence of the DOI representative on ROT. Continuing water pollution control techniques employed by OSC in Phase II which may cause or contribute the dangerous navigational situations, affect the public health or safety, or National security must be concurred in by the representative on ROT of the agency having concomitant jurisdiction.

The OSC is assigned responsibility for the conduct of Phase III activities, utilizing techniques concurred in by the DOI representative on ROT. Phase III activities which may cause or contribute to dangerous navigational situations, affect the public health or safety, or National security must receive the concurrence of the representative on ROT of the agency having concomitant jurisdiction.

Phase IV activities shall be carried out by the individual agencies in accordance with existing statutes, with such assistance as is needed from other signatory agencies.

Additional Procedures Applicable to Certain Pollution Incidents

Delegation of authority or concurrence in proposed or continuing water pollution control activities may be either verbal or written by the DOI representative on ROT.

In the event that a potential pollution source moves from the area covered by one contingency plan into another the authority to initiate pollution control actions shall shift with the potential source. In the event that a pollution incident affects areas covered by two or more regional plans, the response mechanism called for by both plans shall be activated, however, pollution control actions shall be fully coordinated as detailed in the regional plans.

With regard to federally owned or operated vessels or other facilities, in any geographical area, the initial actions under the Reaction Phases, described elsewhere in this report, will be taken by that department or agency owning or responsible for operation of the vessel or facility. Continuing water pollution control actions taken under Phases II and III must be concurred in by the DOI representative on the appropriate ROT.

In the event of a nuclear pollution incident the procedures of the Interagency Radiological Assistance Plan shall apply.

ANNEX I

This plan is an agreement entered into by the heads of the agencies listed below. Any signatory agency may withdraw from the agreement on 30 days notice to each of the other agencies.

The Plan may be modified through procedures described in the plan with the written consent of the Secretaries of the Interior, Transportation, Defense, Health, Education and Welfare, and the Director, Office of Emergency Planning.

Annexes to the plan, detailing procedures for executing the Plan, may be modified by the representatives to the National Interagency Committee with the approval of the Secretary of the Interior.

Regional Plans may be modified by the Department of the Interior with the concurrence of the agencies affected by such changes.

1. U. S. Department of the Interior Stewart Udall
Secretary

2. U. S. Department of Transportation Alan S Boyd
Secretary

3. U. S. Department of Defense
Secretary

4. U. S. Department of Health, Education, and Welfare Wilbur J Cohen
Secretary

5. Office of Emergency Planning Price Daniel
Director

ANNEX II

DISTRIBUTION OF PLAN

For the most effective operation of the plan, coordination with and the cooperation of many Federal, State, interstate, and local agencies will be necessary. To this end, the following agencies will be included in the distribution and other information relevant to the operation of this Plan:

1. The agencies signatory to this plan and the offices designated within their agencies. These include:

(a) All FWPCA Regional Offices;

(b) All Coast Guard District Commanders;

(c) All USPHS Regional Health Directors;

(d) Department of Defense, and

(i) All Corps of Engineers District and Division Engineers

(ii) All U. S. Navy District Commanders

(iii) All Continental Army Commands

(e) Office of Emergency Planning Regional Directors.

2. All State water pollution control agencies.

3. All interstate water pollution control agencies.

4. The Department of Justice.

Formal distribution of the plan and other relevant information will be handled by the U. S. Department of the Interior, Federal Water Pollution Control Administration. Informal distribution to others not listed above may be handled by the Department or agency concerned.

Tabulations of the agencies receiving the distribution are attached.

ANNEX III

A SUMMARY OF LEGAL CAPABILITIES AVAILABLE TO THE UNITED STATES TO CONTROL OIL POLLUTION

I. Oil Pollution Act, 1924, as amended, (33 U.S.C. 431 et. seq.) now makes unlawful, with some exceptions, the grossly negligent or willful discharge of oil into the navigable waters and adjoining shorelines of the United States from a vessel. This prohibition applies to foreign and domestic vessels within our territorial sea and navigable inland waters. The Act establishes both civil and criminal sanctions for violations. The exceptions are cases of emergencies imperiling life or property, and unavoidable accidents, collisions, or strandings, and those cases where discharges are permitted by regulation. The Act authorizes the Secretary of the Interior to issue regulations which:

Permit the discharge of oil from boats or vessels in such quantities, under such conditions, and at such times and places as in his opinion will not be deleterious to health or marine life or a menace to navigation, or dangerous to persons or property engaged in commerce on navigable waters of the United States; and

Relate to the removal or cost of removal or both, of oil from the navigable waters of the United States, and adjoining shorelines of the United States.

The Act further provides for a coordinated action program by allowing the Secretary of the Interior to make use of the organization, equipment and agencies of the Coast Guard and Army with the consent of the

Commandant and Secretary, respectively. The 1966 amendment to the Act inserted reference to persons employed under authority of the Secretary of the Army for the better enforcement of the Act.

II. An act to authorize Federal assistance to State and local governments in major disaster and for other purposes (42 U.S.C. 1855 et. seq.). By Executive Order 10427, dated January 16, 1953, the President has delegated administration of the Federal disaster assistance program under Public Law 81-875, cited above, to the Director, Office of Emergency Planning. This includes the authority to coordinate and direct the disaster relief activities of all Federal agencies during a major disaster and when a major disaster is declared by the President, and to administer disaster relief funds made available by Congressional appropriation to the President. The Disaster Relief Act of 1966, Public Law 89-769, reaffirmed the Office of Emergency Planning's role in planning and directing Federal disaster assistance activities.

In a disaster of major proportions, the Office of Emergency Planning will make damage assessment through such agencies as the Corps of Engineers, Bureau of Public Roads, Department of Health, Education, and Welfare, and the Department of Housing and Urban Development.

After the President declares a major disaster, the Office of Emergency Planning may direct any Federal agency to provide assistance to:

> Utilize or lend, with or without compensation, to State and local government, equipment, supplies, facilities, personnel, and resources other than extension of credit under the authority of any Act.
>
> Distribute, through the American National Red Cross or otherwise, medicine, food and other consumable supplies.
>
> Donate or lend to States, for their use or distribution surplus equipment and supplies.
>
> Perform, on public or private lands, protective and other work to preserve life and property.
>
> Provide temporary housing or

emergency shelter.

Clear debris and wreckage, and make emergency repairs and temporary replacement of essential public facilities, such as roads, bridges, water and sewer systems, public buildings, of State and local governments.

The Office of Emergency Planning may render financial assistance to:

State and local governments for work to protect life and property, to clear debris and wreckage, and to make emergency repairs to and temporary replacements of essential public facilities of State and local governments, including provisions for temporary housing or emergency shelter.

Federal agencies as reimbursement for disaster relief assistance directed by the Office of Emergency Planning.

Statutory and Legal Authorities pursuant to which OEP operates are:

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Public Law 81-875 (42 U.S.C. 1855-1855g). Executive Order Nos. 10427 and 10737, as amended, Parts 1709 and 1710 of Title 32 of the Code of Federal Regulations (32 C.F.R. Part 1709, 1710.)

Section 12 of Public Law 89-769 (42 U.S.C. 1855hh).

The Department of Defense cites the basic law, 42 U.S.C. 1855-1855g, as its principal authority in responding to civil assistance situations upon the determination by the President that disaster assistance is warranted and a governor's certification of need for such assistance.

III. The Rivers and Harbors Act, also cited as The Refuse Act of 1899, (33 U.S.C. 407) is administered by the Corps of Engineers and applies to both vessels and shore-based facilities with respect to almost every type of discharge to a navigable water except that flowing from streets and sewers. A 1965 judicial ruling construed the Act to include the discharge of commercially valuable gasoline.

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The Corps of Engineers also participates in oil pollution incidents in accordance with the provisions of Public Law 81-875, as amended (42 U.S.C. 1855) known as the Federal Disaster Relief Act, described above.

The Corps of Engineers can perform work for other Federal agencies. This authority is contained in Section 219 of the Flood Control Act of 1965, Public Law 89-298, which states, "The Chief of Engineers, under the supervision of the Secretary of the Army, is authorized to accept orders from other Federal departments and agencies for work or services and to perform all or any part of such work or services by contract."

IV. Legal Authorities Under Which the U. S. Coast Guard Operates Relating to Water Pollution Control May be Summarized as Follows:

A. Primary Duties

The Coast Guard shall enforce or assist in the enforcement of all applicable Federal laws upon the high seas and waters subject to the jurisdiction of the United States; shall administer laws and promulgate and enforce regulations for the promotion of safety of life and property on the high seas and waters subject to the jurisdiction of the United States covering all matters not specifically delegated by law to some other executive department; shall develop, establish, maintain and operate, with due regard to the requirements of national defense, aids to maritime navigation, ice breaking facilities, and rescue facilities for the promotion of safety on and over the high seas and waters subject to the jurisdiction of the United States, and shall maintain a state of readiness to function as a specialized service in time of war. (14 U.S.C. 2).

B. Functions and Activities Relating to Water Pollution Control.

1. Saving of life and protecting the property (14 U.S.C. 88).
2. Providing aids to maritime

and air navigation (14 U.S.C. 81).

3. Providing for the safety of naval vessels (14 U.S.C. 91).
4. Administering the Merchant Marine Safety Program (Title 46 U.S.C.)
5. Operating an effective port security and safety program (50 U.S.C. 191 and Executive Order 10173, as amended).
6. Enforcing or assisting in the enforcement of Federal laws on the high seas or waters subject to the jurisdiction of the United States, for example:
    a. Oil Pollution Act 1961 (33 U.S.C. 1001)
    b. Refuse Act of 1899

(33 U.S.C. 403 et. seq.)

c. Oil Pollution Act of 1924, as amended (33 U.S.C. 431 et.seq.)

d. "Dangerous Cargo Act (46 U.S.C. 171)" activities now covered by 18 U.S.C. 278 (46 U.S.C. 171, as such, has been repealed.)

7. Administering the Tank Vessel Act (46 U.S.C. 391a)

V. The Federal Water Pollution Control Act, as amended, (33 U.S.C. 466, et.seq.). The Secretary of the Interior Administers the Federal Water Pollution Control Act, as amended, through the Federal Water Pollution Control Administration.

The Act has as its stated policy "to enhance the quality and value of our water resources, and to establish a national policy for the prevention, control and abatement of water pollution."

Under section (5)(b) of the Act, the Federal Water Pollution Control Administration may participate in an oil or other hazardous materials pollution incident and make recommendations for the solution of the problem, at the request of a State or interstate water pollution control agency. Section (5)(b) states:

> "The Secretary may, upon request of any State water pollution control agency, or interstate agency, conduct investigations and research and surveys concerning any specific problem of water pollution confronting any State, interstate agency, community, municipality, or industrial plant, with a view of recommending a solution of such problem."

The Federal Water Pollution Control Administration may also provide technical assistance to public and private agencies under section (5)(a) of the Act. This section states:

> "The Secretary shall conduct in the Department of the Interior and encourage, cooperate with, and render assistance to other appropriate public (whether Federal, State, interstate, or local) authorities, agencies, and institutions, private agencies

> and institutions, and individuals in the conduct of, and promote the coordination of, research, investigations, experiments, demonstrations, and studies, relating to the causes, control, and prevention of water pollution."

Under the enforcement provisions of the Act it is stated in section 10 (a):

> "The pollution of interstate or navigable waters in or adjacent to any State or States (whether the matter causing or contributing to such pollution is discharged directly into such waters or after discharge into a tributary of such waters), which endangers the health or welfare of any persons, shall be subject to abatement as provided in this Act."

In enforcement actions held under the procedures described in section 10, the Secretary, where appropriate, may make recommendations for limits on various pollutants, including oil and other hazardous materials. If effective progress toward abatement of the pollution is not made in these enforcement actions, more stringent enforcement measures may be taken under the Act.

Water quality standards, as provided in section 10 of the Act, where appropriate, have included oil and other hazardous materials. The Act provides for enforcement procedures to insure compliance with the water quality standards.

VI. The Outer Continental Shelf Lands Act (43 U.S.C. 1331-1343), authorizes the Secretary of Interior to require the prevention of pollution in offshore oil or mining operations. In the implementation of this Act, a requirement for compliance with antipollution regulations could be made a condition of any lease, with failure to comply making the lease revocable.

ANNEX IV

NATIONAL INTERAGENCY COMMITTEE (NIC)

1. Purpose

The purpose of the National Interagency

Committee (NIC) is to provide an advisory body to insure the viability of the operating program of the Federal Government to deal with spills of oil and other hazardous substances.

2. Objectives

a. To review the national and regional plans periodically for adequacy and effectiveness, and to recommend changes to these plans as necessary.

b. To review major and catastrophic pollution incidents with a view to improving the plans and to make such recommendations to the signatory agencies as indicated and appropriate.

c. To encourage joint demonstrations, projects and exercises of forces of signatory agencies.

d. To review exercise reports and to submit an annual report to the signatory agencies concerning the readiness of the national and regional plans and forces to cope with a major or catastrophic water pollution incident.

3. Composition

a. The representative of DOI shall serve as chairman of the Committee, and the representative of DOT as vice-chairman.

b. Membership shall be comprised of representatives of the Federal agencies having statutory responsibilities pertaining directly to water pollution or its effects. The original membership shall be comprised of the following agencies:

Department of the Interior
Department of Transportation
Department of Defense
Office of Emergency Planning
Department of Health, Education, and Welfare

c. Provisions are made for observers and consultants on a nonreimbursable basis from other Federal, State or local agencies and industry as circumstances warrant. The objective of maintaining a broadly-based organization and response is in consonance with the legislation on oil and hazardous pollution.

ANNEX V

JOINT OPERATIONS CENTER

1. The National Joint Operations Center (JOC) for Oil and Hazardous Materials Water Pollution Incidents is established at United States Coast Guard Headquarters, Washington, D. C. (20591) in Room 7133.

2. Purpose

The purpose of the JOC is to provide an effective physical means for coordination and control of an incident should National level involvement be required.

3. Activation

a. The JOC may be activated by any interested agency through its representative member of the JOT.

b. Activation may take place immediately upon receipt of information of a major water pollution incident.

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c. Immediate notification of activation to participating agencies will be made by appropriate means using the words "JOC Activated at (date and time) Z" (Greenwich Mean Time or Zulu Time).

4. Responsibilities

a. The Commandant, U. S. Coast Guard will provide the necessary communications and plotting facilities and equipment. This will include:

(1) Telephone branch lines

(2) Teletype circuits

(3) Adequate charts of U. S. navigable waters, the continental shelf and the ocean areas adjacent to U. S. territorial waters.

(4) Technical library on oil and hazardous materials pollution.

(5) Plotting and display provisions to visually depict the geographic position, movement and extent of the pollutant.

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b. Signatory agencies will furnish competent representatives to man the JOC as required and furnish appropriate technical manuals and materials and such administrative support as required.

c. The Coast Guard Duty Officer, pursuant to his standing instructions, will provide initial notification of a pollution incident to the Coast Guard member who is the Executive Secretary who will subsequently notify the members of JOT.

5. Communications Services Available

a. Telephone (voice)

(1) AUTOVON (Automated Voice Network) - general purpose switched voice network of Defense Communications System. Serves CONUS, Alaska, Europe, Pacific and Panama.

(2) Washington Tactical Switchboard

Pentagon terminal of the tactical telephone system, operated by USAF.

(3) FTS - **GSA** operated government administrative telephone system.

(4) SARTEL - SAR COMMAND COORDINATION telephone network. Leased HOTLINE telephone net extending from Halifax to New Orleans.

b. Teletype

(1) AUTOVON. A defense communications worldwide. High speed user data communications system operated for and managed by the DCA to provide both direct user to user and store and forward message switching service for DOD and other government agencies.

(2) SARLANT - Coast Guard leased teletype system extending from Massachusetts to Texas and Missouri and Ohio. Used to control and coordinate SAR incidents under

CEA and handles other operational traffic and priority administrative communications.

(3) SARPAC - Same as (2) for the West Coast U. S.

(4) TWX - Teletypewriter exchange service links 50,000 CONUS industry and government offices. Also has overseas capability.

6. Weather Information

a. Telephone (voice) with the Weather Bureau for domestic and oceanic weather and forecasted conditions.

7. Ocean Conditions

a. Telephone and teletype connections to the Commander, Eastern area for ocean surface conditions and forecasted conditions.

ANNEX VI

REGIONAL OPERATIONS CENTERS

(Listing of Regional Operations Centers will be inserted after designation in the Regional plans.)

ANNEX VII

SHIP SALVAGE AUTHORITY OF THE U. S. NAVY AS RELATED TO OIL SPILL EMERGENCIES

As set forth in Public Law 513 (80th Congress, 2nd Session, 10 USC 7361, et. seq.), the Secretary of the Navy is authorized to provide, by contract or otherwise, necessary salvage facilities for both public and private vessels upon such terms and conditions as he may, in his discretion, determine to be in the best interests of the United States. In addition to the responsibilities which the Navy would assume in applying salvage techniques to cope with a potential pollution problem involving a U. S. Navy vessel, Public Law 80-513 authorizes the use of Navy facilities for salving public and private vessels at the request of competent authority. The following examples are used to illustrate the responsiveness of Navy salvage forces to pollution incidents and to further delineate the relationships whereby Navy salvage forces would respond to assist other "competent authorities" in coping with potential pollution problems:

(a) U. S. Navy ship aground: pollution threat to surrounding environment. The Navy would acknowledge total responsibility for the operation. Acting in accordance with promulgated Naval directives, Navy salvage forces would automatically respond to cope with the salvage aspects of the problem. The Navy would seek USCG and FWPCA assistance to deal with a pollution threat which might exist during salvage efforts or which might develop should initial salvage efforts prove unsuccessful.

(b) Any vessel aground: pollution threat to U. S. Territorial waters. As provided for in Naval directives promulgated in response to Public Law 80-513,

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the Navy may, subject to the availability of forces, respond to a request from competent authority for salvage assistance to save the ship and cargo. Provided it has not been abandoned, arrested, or in some manner come under Governmental control, competent authority in the case of a merchant vessel will ordinarily be the ship's master, owner, agent, or authorized underwriter's representative. In such cases, the customer is the ship's master, owner, agent or underwriter and the Navy provides salvage services that are governed by the appropriate Naval directives. Due regard must, however, be given to the existence locally, or the reasonable availability, of privately owned salvage facilities.

On the other hand, if a competent Governmental agency, such as the USCG, FWPCA, Corps of Engineers, Office of Emergency Planning, or a Federal court has stepped into the case, and, acting in the public interest to prevent or minimize pollution, requests Navy salvage assistance as an evolution of the oil pollution control operation, and acknowledge that it is the "customer," Navy salvage assistance may be provided in consonance with the provisions of Public Law 80-513. In such cases, the operation will be considered to be one of cross-servicing within the government and the existence of local salvage capability may be considered subordinated thereto.

If the ship has been abandoned it may be expected that some agency of the local, State or Federal Government will have assumed at least interim possession and will be in a position to act as competent authority to request salvage, and act as "customer." In such a case, the operation will again be considered as one of cross-servicing and it may proceed as above. Similarly, if the ship has been arrested, the salvage assistance will be governed by the directions of the competent court.

(c) Wrecked vessel of any flag blocking a U. S. Territory navigation channel. Under the Rivers and Harbors Act of 1889, the Army Corps of Engineers has the responsibility for wreck removal and can exercise this authority, if necessary, prior to abandonment of the vessel by the owners and underwriters. Accordingly, Naval salvage forces may respond to a request for salvage assistance from the Corps of Engineers which would act as the competent authority and "customer" in such a case.

Even though the Corps of Engineers can deal with the Navy or with commercial salvors for wreck removal as noted above, it does not have removal authority solely for the purposes of minimizing leakage of oil or potential oil leakage. Antipollution action must be taken by the USCG or the FWPCA.

(d) Wrecked vessel of any flag in navigable waters: pollution threat to U. S. Territorial waters; not blocking a channel. Although current legislation is imprecise in defining a territorial separation or overlap in the area responsibilities of the USCG and the FWPCA, both organizations have broad authorities (in effect and pending) under the provisions of the Federal Water Pollution Control Act and the Oil Pollution Act of 1924 to prevent, control and correct the effects of oil pollution. Accordingly, it is the policy of the Navy to respond to requests for assistance from either of these organizations to provide salvage assistance in dealing with potential or actual oil pollution incidents.

ANNEX VIII

COMMUNICATIONS AND REPORTS

Purpose

The communications concerning a major oil or hazardous material spill are an integral and significant part of the operations. The same precepts govern in these instances as do other operations in which the Coast Guard and other operating agencies are involved.

Objectives

(a) To speed the flow of information

pertaining to an incident.

(b) To relay advice, instructions and reports pertaining to an incident.

(c) To provide for alerting, notification, surveillance and warning of a pollution incident.

Procedures

(a) Normal communications circuits of each signatory agency may be used to effectuate this plan. The national and district or regional offices and telephone numbers of primary alerting and notification offices of interested agencies will be maintained in JOC and as appropriate in ROC.

(b) The initial reporting of a pollution incident will be in accordance with the information and format as described in the regional plans.

(c) SITREPS (Situation Reports) will be forwarded by the OSC to his operational commander, with ROC, or JOC, or both, as appropriate, as informational addresses.

1. Such reports will be submitted in a timely manner as developments occur and at 0800 and 2000 local time on each day of the operation.
2. Participating agencies will be kept advised of the information contained in such reports through their representatives on the JOT or ROT, as applicable.

Reports

At the conclusion of Federal activity resulting from a pollution incident, any OSC involved will submit a complete report of the incident and the actions taken, pursuant to applicable directives of his own agency. Copies will be furnished to the JOT or ROT, as appropriate, for submission to the NIC, together with any other pertinent information available to the forwarding group. The NIC will then evaluate each incident and will make appropriate recommendations as provided in Annex IV.

ANNEX IX

STATE AND LOCAL GOVERNMENT AND PRIVATE INTERESTS

Under this plan, private, State, local and Federal responses to pollution incidents will be fully coordinated to achieve the most effective pattern of response. Additionally, this plan encourages the development of State and local government capabilities and private capabilities to handle such pollution incidents.

To accomplish both the development of capabilities and coordination of responses, the State and local agencies having response and resource capabilities are encouraged to participate in the regional planning necessary to accomplish the objectives of this plan. The formation of State and local action teams to develop and participate in programs designed to handle pollution incidents appears desirable, and the agencies signatory to this plan will encourage and assist in the establishment of such teams and local alerting systems for pollution incidents. Additionally, the purchase of appropriate equipment and materials by States, localities, and private interests for use in pollution incidents is suggested.

The States and local agencies have primary responsibility to enforce their own laws and regulations relating to pollution incidents. Phase IV activities under this plan, will be performed so as to accommodate, whenever possible, State and/or local requirements for enforcement of their laws.

The Governor of a State has the responsibility to ask for the declaration of a Major Disaster, whenever appropriate. The regional plans will assist in such instances by providing an orderly Federal-State-local response to a pollution incident.

In accordance with the established Federal policy for oil pollution incidents, the person responsible for the discharge of oil or other hazardous substances causing pollution will be encouraged to remove the pollutant or adequately mitigate its effects. If the person responsible does not act promptly or does not propose to take necessary and appropriate action, as concurred in by the DOI representative on ROT, to contain, clean up and dispose of pollutants, or the discharger is unknown, further Federal response actions as described in the plan may be instituted. When such person is taking adequate action, Federal activities will consist primarily of observing and monitoring progress, and providing whatever advice and counsel may be necessary.

The specific details concerning State, local and private involvement in response operations for pollution incidents will be spelled out in the regional plans.

ANNEX X

FUNDING

The central thrust of this plan and existing statutes is that the cost of containment, countermeasures and cleanup with respect to spills of oil or other hazardous materials shall be borne by the person (as defined by the Oil Pollution Act of 1924) permitting or causing the spill.

Actions undertaken by the agencies signatory to this plan in response to pollution emergencies shall be carried out under existing programs so far as practicable. It is recognized, however, that the separate agencies have funds available specifically for dealing with pollution and related incidents.

Although it is not envisioned that specific reimbursement agreements between Federal agencies will be needed to insure that the Federal resources will be available for a timely response to a pollution emergency, this plan does not preclude such agreements.

The Department of the Interior has made available, through administrative direction within FWPCA, $10,000 per region for expenditure on cleanup operations.

The U. S. Coast Guard pollution control efforts are funded under "Operating Expenses."

The Department of Defense. In addition to having statutory responsibility to provide assistance in the event of a declared disaster has two specific sources of funds. These are:

1. Funds required for removal of a sunken vessel or similar obstruction to navigation are available to the Corps of Engineers through Civil Functions Appropriations, Operations and Maintenance, General.

2. The U. S. Navy has funds available through its salvage operations.

Office of Emergency Planning. In making a declaration of a major disaster for a stricken area, the President may allocate funds from his Disaster Relief Fund. The allocated funds are administered by the Director, Office of Emergency Planning. The Director may authorize reimbursement to other Federal agencies for disaster assistance directed by the Office of Emergency Planning. Applicable policies and procedures are stated in Title 32, Chapter XVII, Part 1709 "Reimbursement of Other Federal Agencies Performing Major Disaster Relief Functions."

The Director may make financial assistance available to State governments and through the States to local governments in accordance with policies and procedures stated in Title 32, Chapter XVII, Part 1710 Federal Disaster Assistance.

ANNEX XI

PROCEDURES FOR REPORTING INFORMATION AND COLLECTING SAMPLES IN PHASE IV OPERATIONS

(Recovery of Damages and Enforcement)

The OSC in charge at the scene of a pollution incident may be from any one of several agencies. Therefore, it is necessary to establish uniform procedures for notification of counsel, collection of samples and information consistent with the several phase operations in Federal response situations. Necessary information and sample collection must be performed at the proper times during the Federal involvement in a pollution incident for the purpose of later use in cleanup cost recovery, damage recovery, and civil and criminal enforcement actions, under appropriate Federal statutes. Thus, during the phase operations of discovery and notification, containment and countermeasures, and cleanup, restoration and disposal, the OSC must take the necessary action to put counsel on notice of the event and to ensure that information, records and samples adequate for legal purposes are obtained and safeguarded for future use.

Notification of Counsel

A. Immediate Telephone Notice

Immediately upon notice of the discovery of a pollution incident, the RCT and JOT members shall notify their respective regional and departmental attorneys, as provided herein and as detailed in the regional plan.

Legal notice to the ship operator and owner indicating Federal interest and action in an incident shall be prepared and sent, using Form No. FWPCA 207(7-68), shown on page XI-7, this annex. Counsel will advise regarding specific changes or citations to be added to this notice.

Immediate coordination of counsel of the Department of the Interior, Corps of Engineers and the Coast Guard, at the Washington, D. C., level and the regional level, will be effected for joint and several actions concerning sending of notices, advices regarding the handling of evidence, preparation of evidentiary statements, and referral of the matter to the Justice Department or the appropriate U. S. Attorney.

B. Transmittal to Counsel of Reports and Evidentiary Materials

The information and reports obtained by the OSC are to be transmitted directly to the ROT. The representative of the agency on ROT having cost recovery or enforcement authority will then refer copies of the pollution reports to his respective departmental counsel.

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Investigation, Collection of Samples and Reporting

Samples collected are to be transmitted, using procedures detailed below, to the laboratory designated in the regional plan for analysis. Reports of laboratory analyses will be forwarded to the appropriate ROT for transmittal to counsel. The Chairman, ROT, will also forward copies of laboratory reports to JOT. Procedures for handling of samples and records are described below.

A. Action to be taken by OSC for Phase IV Activities in Conjunction with Actions in Phase I, II and III

(1) Investigate observed instances of oil or other hazardous materials pollution in the waters covered by the scope of this plan.

(2) Collect samples of oil or hazardous materials from the water and from appropriate spaces of the suspected offending vessel or vessels, shore establishments, or other sources, when investigation discloses a

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reasonable basis to believe a violation has occurred. (See B, below)

(3) Prepare Oil Pollution Incident Report (Form No. FWPCA 209, (7-68) shown on page 931.) together with additional documents or attachments, if any.

(4) Transmit the original and one copy of Form No. FWPCA 209 (7-68) and attachments to the appropriate ROT Chairman at ROC. A copy of the form and attachments are to be forwarded to the Chairman JOT. Samples are to be sent directly to the laboratories designated in the regional plans.

(5) Such material should be mailed by air mail (wherever possible), special delivery, registered-return receipt requested. Reports sent from the laboratories to the

Chairman ROT should also be mailed in this manner.

(6) Chain of Custody: It is important that a chain of custody of the samples be properly maintained and recorded from the time the samples are taken until ultimate use at the trial of the case. In this regard, a record of time, place, and the name and title of the person taking the sample, and each person handling same thereafter must be maintained and forwarded with the sample, using the Form No. FWPCA 208 (7-68) shown on page 930.

(7) If in any doubt as to whether or not any particular occurrence may be an oil pollution or hazardous materials pollution violation case, or in any doubt as to how to proceed in any given case, contact the

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ROT for instructions and advice. If, however, time is a critical factor and/or the ROT has not yet assembled, proceed as if the incident were a pollution violation.

B. Sample Collection Procedures to be followed by OSC in Phase IV Activities.

(1) Several precautions must be observed when taking and handling liquid samples for analyses as the character of the sample may be affected by a number of common conditions. These precautions concern:

a. The composition of the container;
b. Cleanliness of the container;
c. Manner in which the sample is taken; and
d. Time elapsed between sampling and analysis.

(2) In taking such samples, the following procedures are to be followed in all cases:

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a. Glass containers of one quart size are to be used. The portion of the cap or cap liner which may come into contact with the sample in the container is to be made of glass, aluminum foil, or teflon.

b. Previously unused containers are preferred. Containers that have been cleaned with a strong detergent, thoroughly rinsed and dried may be used.

c. Samples must be properly labeled.

d. Consultation: Consult with the analysis laboratory personnel relative to special samples and unusual problems. In this regard, Department of Interior laboratories will advise on procedures and unusual sampling problems. Inquiries may be made or addressed to the appropriate DOI laboratory in the area. Locations of DOI laboratories are given in the regional plans.

e. Some explanatory notes covering the above procedures:

Glass containers always must be used because plastic containers, with the exception of teflon have been found in some cases to absorb organic materials from water. In other cases compounds have been dissolved from plastic containers. This comment also applies to bottle cap liners.

It is sometimes difficult for a chemist to analyze the impurity. Therefore, it is desirable to take as large a sample of the pollutant as possible. Proper skimming techniques should be used to obtain a sufficient amount of oil for analysis.

When water is polluted, it is not unusual for the pollution condition to change rapidly. Samples should be taken in a timely fashion, and the time sequences and place appropriately noted.

OIL POLLUTION INCIDENT REPORT

A. The following information, where appropriate, for each pollution incident, should be obtained by the OSC and reported, pursuant to the instructions above and paragraph B below. Form No. FWPCA 209 (7-68), to facilitate recording and processing this information, will be supplied to the OSC by the FWPCA. This form appears on page 931.

B. Instructions for preparation of Form FWPCA 209 (7-68)

(1) The OSC shall designate an identification number, in consecutive order, to each case. This case number should be placed at the top right hand corner of the form. The same number should also be placed on the cap of each sample obtained, as well as on the "chain of custody" tag or label affixed to each sample. Each regional area will be assigned a distinguishing letter code

which will precede the case number. The ROT shall assign an appropriate identification number for each case and will inform the OSC of the assigned number.

(2) At least four copies of this form are to be prepared for forwarding. The original and one copy are to be transmitted to the Chairman of the appropriate ROT. One copy is to be transmitted to JOT. A copy is also to be transmitted to the supervisory headquarters authority of the OSC.

(3) Section III, Pollution Data. It is not always possible to obtain signed statements from persons directly concerned in a violation case. These signed statements are desirable, if reliable and obtained on a voluntary basis. Oral statements or comments made to or in the presence of the investigating officer also should be described in a statement by the investigating officer and attached to the report. Reference to such statements should be noted on this form

and attached as an Annex.

(4) Section IV, Samples. The "Remarks" (item No. 31) portion of this section need not necessarily be brief. Include any facts, observations, or any information that may be helpful to the reviewing official in making a determination as to whether or not there is sufficient evidence for prosecution.

(5) In the space marked "first endorsement" the OSC should indicate that the original of this form has been forwarded to the appropriate ROT Chairman. The endorsement should also indicate that samples, if any, have been forwarded to the appropriate laboratory indicated in regional plans. When the OSC is informed by the ROT and the laboratory that the reports and samples have been delivered, he will then forward the registered mail receipts to ROT for their files.

U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

LEGAL NOTICE TO SHIP OWNER, OPERATOR, AND CAPTAIN

XI - 7

FROM	NAME OF VESSEL
	ADDITIONAL ADDRESSEES
TO	

The United States, acting through the U. S. Department of the Interior, hereby notifies the vessel and owners of the ______________ (NAME OF VESSEL) and its Captain, ______________ (NAME) through the ______________ (NAME) Steamship Company local agents, of pollution situation created by ______________ (ACTION CAUSING POLLUTION) from the ______________ (NAME OF VESSEL) on ________ (DATE), with discharges of substantial quantities of oil from the ship in navigable waters.

The United States hereby requests and demands that the vessel and its Agents forthwith contain, clean up, and abate the oil pollution situation created by the spill or discharge of oil.

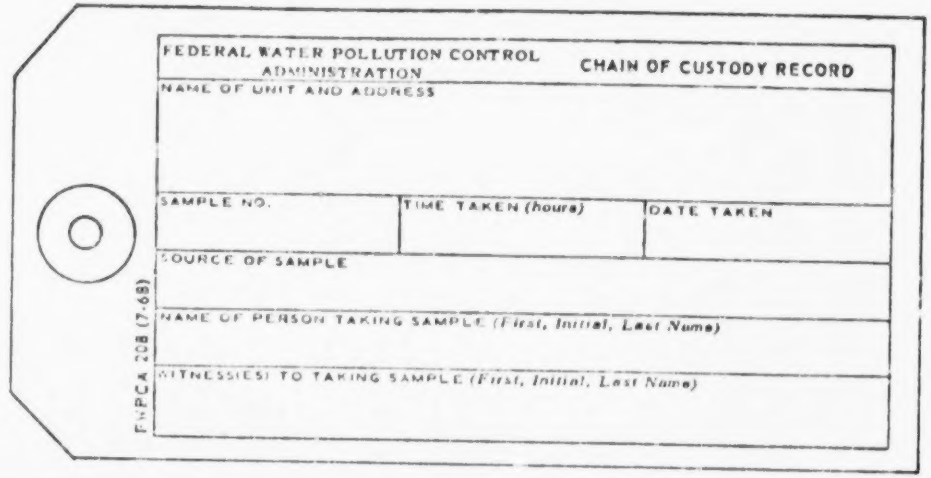
The United States hereby requests that the ______________ (NAME) Steamship Company, acting for and in behalf of the vessel immediately report to the Federal Water Pollution Control Administration, U. S. Department of the Interior, ______________ (ADDRESS) as to the immediate steps so far taken and the immediate steps that the vessel Captain, owners, and agents will take to contain, clean up, and abate the oil pollution situation.

Upon failure to remove the oil from the navigable waters of the United States and from the adjoining shorelines immediatley, the vessel owners, and its agents, the ______________ (NAME) Steamship Company are hereby notified that the Secretary of the Interior, pursuant to the provisions of the Oil Pollution Act of 1924, as amended, will arrange to remove the oil and that the United States shall proceed to hold the vessel and owners liable for all costs and expenses incurred and for all other damages caused the United States.

If subject vessel denies responsibility for the oil discharge, it is respectfully requested that this office be advised immediately of the basis for such denial.

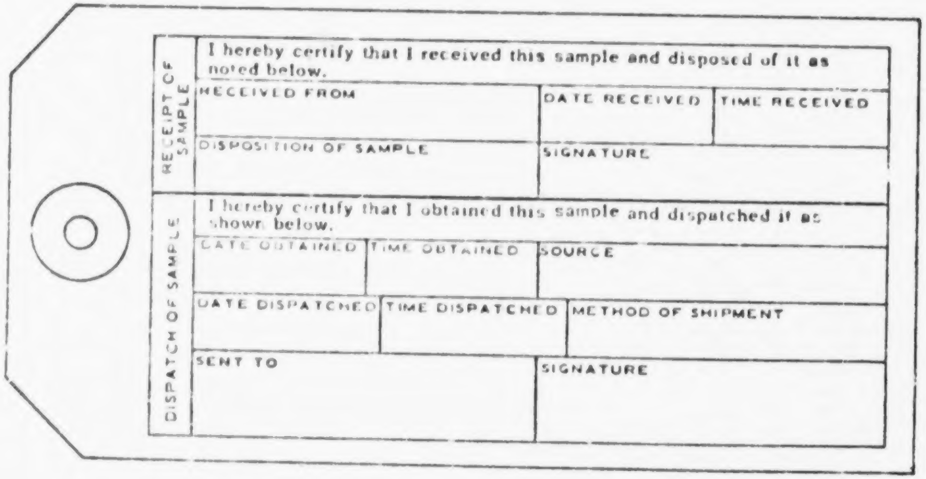
FOR THE REGIONAL DIRECTOR, U. S. DEPARTMENT OF THE INTERIOR (Signature)	ADDRESS

FWPCA 207 (7-68) *(This notice to be transmitted to prime addressee via TWX. Other copies may be dispatched as appropriate.*



FEDERAL WATER POLLUTION CONTROL ADMINISTRATION		CHAIN OF CUSTODY RECORD
NAME OF UNIT AND ADDRESS		
SAMPLE NO.	TIME TAKEN *(hours)*	DATE TAKEN
SOURCE OF SAMPLE		
NAME OF PERSON TAKING SAMPLE *(First, Initial, Last Name)*		
WITNESS(ES) TO TAKING SAMPLE *(First, Initial, Last Name)*		

FWPCA 208 (7-68)



RECEIPT OF SAMPLE	I hereby certify that I received this sample and disposed of it as noted below.		
	RECEIVED FROM	DATE RECEIVED	TIME RECEIVED
	DISPOSITION OF SAMPLE	SIGNATURE	
DISPATCH OF SAMPLE	I hereby certify that I obtained this sample and dispatched it as shown below.		
	DATE OBTAINED TIME OBTAINED	SOURCE	
	DATE DISPATCHED TIME DISPATCHED	METHOD OF SHIPMENT	
	SENT TO	SIGNATURE	

U. S. DEPARTMENT OF THE INTERIOR FEDERAL WATER POLLUTION CONTROL ADMINISTRATION **POLLUTION INCIDENT REPORT**	1. REPORTING UNIT	2. DATE OF REPORT	3. CASE NO.

SECTION I - VESSEL DATA

4. NAME OF VESSEL	5. OFFICIAL NUMBER	6. COUNTRY OF REGISTRY	7. HOME PORT
8. INTERNATIONAL CALL	9. TYPE OF VESSEL *(dry cargo, tanker, etc.)*	10. TYPE OF PROPULSION	11. OTHER IDENTIFYING INFORMATION *(if available)*
12. OWNER(S) OF VESSEL *(name & address)*	13. LOCAL AGENTS *(name & address)*	14. MASTER *(name, address, & license number)*	15. CHIEF ENGINEER *(name, address, & license no.)*

SECTION II - SHORE FACILITY DATA

16. NAME AND ADDRESS OF COMPANY OR INDIVIDUAL	17. TYPE OF FACILITY	18. TYPE OF REFUSE
	19. OTHER IDENTIFYING INFORMATION	

SECTION III - POLLUTION DATA

20. PERSON REPORTING POLLUTION *(name and address if available)* ☐ SIGNED STATEMENT ATTACHED	21. WITNESS *(name & address if available)* ☐ SIGNED STATEMENT ATTACHED	22. PLACE OF POLLUTION *(local name or geographic coordinates)*		22A. TYPE & AMOUNT OF POLLUTANT
		23. TIME	24. DATE	25. PHOTOGRAPH ATTACHED ☐ YES ☐ NO
26. CAUSE OF POLLUTION *(explain in remarks)* ☐ EQUIPMENT FAILURE ☐ PERSONNEL FAILURE	27. TYPE OF LICENSE OR CERTIFICATE HELD BY PERSON RESPONSIBLE	28. EMERGENCY MEASURES TAKEN TO REDUCE FIRE HAZARD		

29. OPERATING PERSONNEL INVOLVED	NAME	DUTY	LICENSE NUMBER *(if applicable)*	SIGNED STATEMENT ATTACHED YES	SIGNED STATEMENT ATTACHED NO

SECTION IV - POLLUTION SAMPLES

30. SOURCE OF SAMPLE	TIME TAKEN	DATE TAKEN	SAMPLE NO.	NAME OF PERSON TAKING SAMPLE	WITNESS

SECTION IV (Continued)

31. REMARKS *(Give full description of incident, including attitudes of personnel and cooperation received. If necessary, continue on blank paper and attach.)*

32. INVESTIGATING OFFICER *(Name and title)*		33. SIGNATURE OF INVESTIGATING OFFICER	33A. DATE SIGNED

FIRST ENDORSEMENT

34. FROM

35. TO

35. SIGNATURE

37. DATE

SECOND ENDORSEMENT

38. FROM

39. TO

40. SIGNATURE

41. DATE

C. Pemberton, Jr.

ANNEX XII

PUBLIC INFORMATION

Any significant spill of oil or other hazardous material inevitably generates a number of urgent requests for information from the news media. It is important, even crucial in many situations, that this information be provided promptly, and that the information be fully coordinated with the agencies concerned and be as complete as possible. Follow-up information should be provided to all interested media as it becomes available.

During pollution emergency operations, the JOC will act as the focal point for national public information releases and for information transfer between the OSC and the Washington, D. C., headquarters of the agencies concerned.

During Federal response operations, the ROT will be responsible for coordinating the interagency information releases at the regional operations level. This will be accomplished by furnishing the news media with information regarding the pollution incident directly from the ROC, or where the ROT determines the situation warrants, a professional information officer will be detailed to the scene of the incident to establish a news media contact office. The information officer at the scene of a pollution incident will coordinate information with the ROT prior to release. Information copies of all formal news releases from the regional level will be forwarded to JOC.

The agency furnishing the OSC in each incident will also provide the necessary information personnel as determined by the ROT. If this agency is unable to provide the necessary information services from its own information resources, the ROT will arrange for the detail of appropriate information personnel from one or more of the signatory agencies.

In cases where the JOT is activated, it may assume direction of any of the public information activities of the ROT to more fully ensure the avoidance of contradictory, overlapping, or uncoordinated national or regional information releases on the same subject.

C. Pemberton, Jr.

ANNEX XIII

TECHNICAL INFORMATION

The technical literature listed in this annex is intended to provide general background information on the handling of spills of oil and other hazardous substances. It should be useful as reference information to the experienced OSC and instructional to less experienced personnel. A complete set of the references should be maintained in each ROC.

1. Information and Procedures for Significant Spills of Oil and Other Hazardous Materials Into the Water Environment (USDI-FWPCA).

2. Chemical Data Guide for Bulk Shipment by Water (U. S. Coast Guard CG-388).

3. Handbook of Toxicology (National Academy of Sciences/National Research Council).

4. Natural Disaster Manual for State and Local Applicants (OEP Circular 4000, 4, 1963).

5. Federal Disaster Assistance (A Pocket Guide to Disaster Help)(OEP Pamphlet).

6. Oil Spill Study, Research Report

(Battelle Northwest, November 1967).

7. Character and Control of Sea Pollution by Oil (American Petroleum Institute, October 1963).

8. Manual for the Prevention of Water Pollution During Marine Oil Terminal Transfer Operations (American Petroleum Institute, 1964).

9. Chemicals Used to Treat Oil on Water, Policy - July 5, 1968, (Copy attached).

10. Current Regional Oil and Hazardous Materials Pollution Contingency Plan.

11. Disaster Plans From Regions, Districts or Facilities of Signatory Agencies as Appropriate.

12. U. S. Corps of Engineers Regulations ER 500-1-1 and ER 500-1-8 Emergency Employment of Army Resources (National Disaster Activities).

DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
POLICY ON THE USE OF
CHEMICALS TO TREAT FLOATING OILS

1. Chemicals should not be used to emulsify, disperse, solubilize, or precipitate oil

whenever the protection or preservation of (a) fresh water supply sources, (b) major shellfish or fin fish nurseries, harvesting grounds or passage areas, or (c) beaches is a prime concern.

Such chemicals should only be used in those surface water areas and under those circumstances where preservation and protection of water related natural resources is judged not to be the highest priority or where a choice as to resource preservation may make the use of such materials a necessary alternative.

2. Examples of areas and circumstances where the use of such chemicals might be acceptable are:

a. Where fire or safety hazards are presented by the spill of a petroleum product;

b. Where large numbers of waterfowl may perish because of the proximity of floating oil;

c. Under certain conditions, as a "polishing" or final cleanup of light slicks of oil following mechanical removal of floating oils.

3. Chemicals that emulsify, disperse, solubilize or precipitate oil should be used only under the immediate supervision of the Federal Water Pollution Control Administration except where it is judged that fire or safety hazards require the immediate application of such chemicals.

4. When chemical compounds are used in connection with oil cleanup, only those compounds exhibiting minimum toxicity toward the aquatic flora and fauna should be used. The Federal Water Pollution Control Administration is now developing and will soon issue a standard procedure for determining the toxicity of such chemicals.

5. Materials which aid in the collection of floating oils such as sorbents, gellants and viscosity additives are considered to be generally acceptable providing that these materials do not in themselves or in combination with the oil increase the pollution hazard.

6. Research and development to improve chemicals which emulsify, disperse, solubilize or precipitate oil is encouraged. Whenever it is demonstrated

to the complete satisfaction of the Federal Water Pollution Control Administration, that such a chemical, by itself and in combination with oil is **nontoxic** its use may be approved in the areas where the protection or preservation of (a) fresh water supply sources, or (b) major shellfish or fin fish nurseries, harvesting grounds or passage areas is a prime concern.

July 5, 1968.

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MR. STEIN: Mr. Poston, do you have any more?

MR. POSTON: We have, in regard to Recommendation No. 22, a report on the alewife situation by Mr. Premetz of the Bureau of Commercial Fisheries.

Mr. Premetz indicated he could give this report in a very few minutes.

STATEMENT OF ERNEST D. PREMETZ
DEPUTY REGIONAL DIRECTOR, BUREAU OF COMMERCIAL FISHERIES, ANN ARBOR, MICHIGAN

MR. PREMETZ: Actually we are talking about another little polluter, the alewife, which turns out to be the anchorman of this Conference. You are all familiar with the alewife skimming operation that was undertaken in Lake Michigan this past year. This was done cooperatively by the four States bordering the lake, the Bureau of Commercial Fisheries and the Federal Water Pollution Control Administration, and we believe that effective gear has now been developed to handle large scale die-offs on the lake. The States now have equipment, pumps, trained people and a cadre of trained commercial fishermen to handle any problem that might come along in the future.

A report of the entire operation is in final draft stage and being reviewed by the States. It should be published by the end of March. A copy will be submitted for the record of this Conference and I ask to the complete satisfaction of the Federal Water Pollution Control Administration, that such a chemical, by itself and in combination with oil is nontoxic its use may be approved in the areas where the protection or preservation of (a) fresh water supply sources, or (b) major shellfish or fin fish nurseries, harvesting grounds or passage areas is a prime concern.

July 5, 1968.

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MR. STEIN: Mr. Poston, do you have any more?

MR. POSTON: We have, in regard to Recommendation No. 22, a report on the alewife situation by Mr. Premetz of the Bureau of Commercial Fisheries.

Mr. Premetz indicated he could give this report in a very few minutes.

that it be entered as part of the Conference minutes.

MR. STEIN: It will be made a part of the record as Exhibit 1 and be on file at headquarters FWPCA and the Great Lakes Regional Office, Chicago, Illinois.

MR. PREMETZ: All right, fine.

Now, the big question that is being asked is what can we expect next year as far as alewife die-off. Our biologists have been carrying on a continuous assessment of the alewife populations in the lake and we find that the adult populations this year, or that is in 1968, were at about the same level as the previous year. Therefore, we expect the same sort of die-off we had last year. In other words, a very minor die-off.

We did find in our sampling that the hatch this past year, the hatch of alewives, was as large as any on record. This coupled with a very large hatch the previous year does make us wonder as far as 1970 and 1972. But we will be able to get a better fix on 1970 this fall when we sample the adult populations and the following fall when we again sample the adult population. We have to wait until they reach adult stage before we can tell just what sort of die-off we might expect.

How do we treat with this problem? Well, we are afraid it is with us for as long as there are alewives in the lake; there will always be die-offs of varying magnitudes, depending upon the success of the hatch of the alewife in any given year.

Will predators or commercial fishing control the alewife? To some extent, yes, but not completely, for the simple reason that you can't build a commercial fishery on an extremely wildly fluctuating population like the alewife nor can you introduce a stable level of predators on a population which has large ups and downs. In other words, you plant at some intermediate level and this will not give you complete control.

So the only thing we can suggest is that during years when there are small die-offs that these be handled on the beaches with the equipment the States may have to take care of it. When we have massive die-offs, that these be handled with the gear that has now been developed, that is the skimming devices that were tested this past year.

That is all I have.

MR. STEIN: Thank you, Mr. Premetz.

Any comments or questions?

If not, thank you very, very much.

By the way, I think in deference to Ernie Premetz, who is the Chairman of this, and with Mr. Princ from the Federal Water Pollution Control Administration this was one of our more successful ventures. We showed that a Federal-State-local cooperation program could be set up. It is fortunate that we didn't get a lot of alewives in 1968 when we expected them, because, while we had a program, I am not sure we could have skimmed them, although we would have made a valiant effort. But with the experience we have I think we know how to do it now. We know a lot more about alewives--by the way, these fellows did a very efficient operation and we even turned money back to the States and the other governments because we didn't have the magnitude of the die-off and we didn't have to spend all the money, and I think that is a recommendation in itself as to how this study was done. It was done very tight and we did get a lot of results.

Thank you very much.

MR. PREMETZ: Murray, thank you for your kind words.

I will say that Murray is very dedicated too. A couple of weeks ago we found him down in New Orleans in the French Quarter checking up on Klassen and his diversion of wastewaters down the Mississippi River.

MR. STEIN: I had a better story than you. You told me you were investigating catfish.

(Laughter.)

MR. POSTON: I would like to call for Ensign Clark, of the Coast Guard, to make a report now. Recommendation No. 20 says that, "The Coast Guard will be requested to report at the next progress meeting on present and future plans for monitoring by aircraft and reporting of pollution of Lake Michigan."

STATEMENT BY ENSIGN MARTIN CLARK
LAW ENFORCEMENT OFFICER, U. S. COAST GUARD
CHICAGO, ILLINOIS

ENSIGN CLARK: Chairman Stein, distinguished Conferees, ladies and gentlemen. I am Ensign Martin Clark, Law Enforcement Officer, Coast Guard Group, Chicago, making this report in response to Recommendation #20 of the Enforcement Conference of February 1968 on behalf of the Commander, Ninth Coast Guard District. As you are aware, it was requested at the February 1968 meeting of this Conference that the Coast Guard report present and future plans for monitoring by aircraft and reporting of pollution on Lake Michigan.

Under the authority of the Refuse Act of 1899 and the Oil Pollution Act of 1924, the Coast Guard is a "detecting and reporting" agency in the enforcement of these regulations. The Coast Guard considers enforcement of the Oil Pollution and Refuse Acts as an active responsibility. The funds for carrying out this function come from the Coast Guard budget, no additional funds have been available to extend Coast Guard activity in pollution control.

Coast Guard participation in the enforcement of Federal water pollution laws is accomplished by the following:

1. Ninth Coast Guard District air stations conduct aircraft patrols of all the Great Lakes with the exception of Lake Ontario, on a weekly basis. (Lake Ontario is inspected twice weekly by Coast Guard aircraft.) These aircraft patrols give the Coast Guard a quick overall picture of water conditions, and act as a deterrent effect to polluters.

2. Surface pollution patrols are conducted by the following Coast Guard units in lower Lake Michigan:

Coast Guard Station S. Haven, Michigan - monthly patrol

Coast Guard Station Michigan City, Indiana - monthly

Coast Guard Station St. Joseph, Michigan - weekly patrol

Calumet Harbor - weekly
patrol of Calumet and
Indiana Harbor areas.
CGC Arundel - weekly patrol
of Chicago area and Chicago
Sanitary and Ship Canal.

3. In addition, Coast Guard port safety personnel from Group Office Chicago conduct pollution patrols in the Calumet and Indiana Harbor areas and the Chicago Sanitary & Ship Canal downstream to Henry, Illinois, on a regular basis. Daily patrols to these areas are conducted, and the effectiveness is considered excellent.

I will summarize by stating that the Coast Guard will continue to actively investigate and report all incidents of pollution which we encounter.

MR. STEIN: Thank you.

Are there any comments or questions?

If not, thank you very much, Ensign.

Are there any other comments or questions?

If not, Mr. Poston, do you have any more?

MR. POSTON: That is the end of our committee reports and Federal presentations.

Summary

MR. STEIN: If we may, now, let's see if we can summarize this. I think the report is so good that we are in effect in a progress meeting operation.

One, from the statements of Illinois, Indiana, Michigan and Wisconsin, I think it is evident, not only evident but we are abundantly clear, that the States under their own programs and the cities and industries within their respective jurisdictions are well on their way to meeting the requirements set by the Conference to clean up Lake Michigan. These largely deal with fixed municipal and industrial sources of wastes and the prospects look--I almost hesitate to use the word "excellent," but I will--excellent for substantial compliance by the date set by the Conference. That is 1972 that we should have this done.

I would like to put one thing out for the Conferees---that on the question whether we adopt the 80 percent phosphorus removal on a Statewide or basinwide basis for each State, let them do that and come up with a schedule for reduction, to give them flexibility in handling their small and large communities and getting the most effective result, the most expeditious and economical way.

MR. POSTON: I think I would be agreeable to that, Mr. Chairman. I think that should be 80 percent of the discharged phosphate from municipal and industrial sources.

MR. STEIN: That is what was proposed-- that the States will make an estimate or compute their phosphate loadings and then come up with their program, indicating they have a total reduction of 80 percent, which is what we were looking for from the beginning. But with the experience with the program,we have indicated that this could be more easily achieved if they did not have to apply that 80 percent to every little point or every major point. Some of the major cities may get 90 percent; some of the little places may not get the 80 percent. But the reduction will be over 80 percent overall.

What do you think of that, Mr. Poole?

MR. POOLE: Sounds reasonable.

MR. FRANGOS: Just a clarification on Mr. Poston's comment. He said "discharged." Our request is on the basis of the input to the treatment plant. Do we have a real problem here?

MR. STEIN: I don't think so. Do we?

MR. POSTON: No.

MR. FRANGOS: All right.

MR. POSTON: I did want to include industrial wastes in this.

MR. FRANGOS: Yes, we understand that.

MR. STEIN: It comes from all sources. I would prefer not to use the word--let me check this--in the summary, Tom.

MR. FRANGOS: Yes.

MR. STEIN: --so there be no misunderstanding. I would prefer not to use the words "input" or "discharge." We are putting "80 percent of the phosphate loading." And I will give you as much flexibility as we can on your computation and how you are going to reduce it.

Because what we are dealing with here is the reduction of the phosphates that go into the lake. We have an allocation for each State and if you meet that allocation you are going to do it. I think we are going to exceed that 80 percent by more if we giv you this flexibility, because any time you have a large city or a large industry with a big problem and you can get them to do 90, we are that much ahead in the pounds.

Yes, sir.

MR. PURDY: I have some reservations with respect to this. In our presentation here we had a cutoff of populations or municipalities with populations less than 2,000 and have instituted a program to require 80 percent removal of the total phosphates from all above 2,000. This now represents roughly 92 percent of the population within the Lake Michigan Basin in those municipalities above 2,000 population. To achieve a total basinwide reduction of 80 percent would require in the neighborhood, if we strictly adhere to this, of 90 percent phosphate removal at those plants. And about one year ago, the testimony that was put into the record at that time indicated clearly that we could look toward achieving a consistent removal of 80 percent or better with the available technology. However, if I remember that testimony by Dr. Weinberger, he also indicated that he couldn't state that for a 90 percent removal.

If we have to strictly adhere now to an

objective where we would look at these larger communities and say we are going to achieve a 90-plus percent phosphate removal, I don't believe that we have the technical testimony in the record to indicate that we can achieve this.

MR. STEIN: I think they put it in last time, Ralph. But as I understand this, the technology has moved ahead to the point that in the larger communities the thinking of the experts now is it is going to cost you about the same to get 90 percent removal as 30 percent removal if you are running a good plant.

I recognize this was set up when it was, and your program got started. Why don't we work it like this: you evaluate it and see what comes out. This is just a question of judgment that if you can get a 90 percent for about the same as an 80 percent, this may solve itself in the Michigan communities.

MR. PURDY: If we can do that within that context, I don't see any problem.

MR. STEIN: Yes, I know.

MR. PURDY: But where we are this far down the road--

MR. STEIN: I recognize that.

MR. PURDY: --on an enforcement program and to change the ground rules at this time and say, now, we didn't mean 80 percent; we mean 90 percent--we have difficulty.

MR. STEIN: Right. I think you have a point. But let us try this. Let us get a report as we have--and we are going to propose progress meetings--on the kind of phosphate reduction we are planning and in fact getting. We are starting something new and whatever the prognosis is, 80 or 90 percent, when these progress reports come in, I assume we are going to have to make adjustments to meet experience and reality and then see what is actually happening. Knowing your program is on the road, let's get a report from all with this understanding that you will continue with your program.

MR. PURDY: I think we lose the confidence of the people that are trying to meet our objectives if we can't make up our mind and keep it over one year.

MR. STEIN: Yes. The difficulty with these fast-moving fields is that you get overtaken by events. The technology, particularly in phosphate removal, has been improving at a very rapid pace, even as we have been meeting and refining this.

Now, I don't view this as a substantial differentiation. What we are going to have to do is gather our experience on the phosphate removal program to see what actually happens. Actually, what we are dealing with here is a new process and new requirement. In a sense, I don't want to put this that we are dealing with a theory that is not going to work, but we are dealing with a theory. We are going to review this from time to time to see what kind of modifications or improvements we have to make on them.

So I believe with that, perhaps, we can go forward.

Now, I have these other reports. Well, let's take the one on which we might get the most agreement. We can more or less adopt the report of the Monitoring

Committee, with the proviso of the consideration that Mr. Frangos from Wisconsin made--they give consideration to adjusting the monitoring point at Two Rivers, Wisconsin, to reflect the results that he indicated in his proposal.

And with that I think the Monitoring Committee is well on its way and can go further. I have a comment from one of the Conferees that the Lab Committee is to meet no more often than six months intervals, which is all right with me. Why don't you save your fights up?

Now, the next one on pesticides, I think there again we have a very active program to be put into effect. As far as the report goes, I would say that we can accept the report or propose that we accept the report of the Pesticides Committee. But in view of the discussions, we have to ask Dr. Mount, possibly, and representatives of the States to get together and embark on an active pesticide monitoring program and data gathering program for the kinds of pesticides which are being used in the basin and where they are being used so we can make a meaningful report. Now, the kind of people you may want to get to work on this other end of the field may not be the scientists that you have working on the measuring operation. But I think we are going to have to have both of these if we are going to come up with meaningful judgments on the pesticides.

Again, I think we maybe are being overtaken by results because various States have legislation to ban completely the use of certain pesticides. If they do it, I guess they do it, but this is something we will have to take into consideration.

The next point I have is the status of agricultural pollution and the steps being taken to alleviate it. Now, I believe we need a report from the States. Again, you may want to do this individually. But I suggest that we set up some kind of committee where we can at least talk in terms of setting up some ground rules for identifying what we are going to include. We should have a report from the States as to 1) what they regard as pollution problems from agriculture, if any, 2) where it is and what programs, if any, are around to alleviate it, and 3) what they would propose or what we would have to do to come up with this program.

With the report we had today we have just taken the first step on this agricultural program. We had a very nice bird's-eye view of the national picture, but I think we have to get this down into the Lake Michigan Basin.

By the way, there should be a report from the States whether cattle feed lots do, in fact, constitute a pollution problem in their State. I don't know what the situation is in these States, but you may be surprised if you look around.

Now we come to the Thermal Pollution and Nuclear Pollution report. Again, I think we should accept that report for what consideration we can give it. But I am not sure that we have the proposals for an action program on that report. What we had--and Mr. Kittrell who gave the report indicated this--was a proposal for further study. This should be considered by the FWPCA and the States if they want, under our program operations,to work on the study.

But I do think that we have to have from the States a recommendation as to what the Conferees are to do, if anything, on controlling nuclear pollution and thermal discharges. We have to determine whether this may be covered by your standards, particularly on thermal pollution, or whether we have to go further and whether we have enough requirements on that.

Again, I am sure you will agree, we have had an interesting first go-round. Perhaps, we don't have to do any more on this, but I don't think we have put that one to rest.

MR. PURDY: Agreed.

MR. STEIN: Right.

MR. PURDY: Murray.

MR. STEIN: Yes.

MR. PURDY: When you say that we are accepting the reports, does this mean that they are being adopted by the Conferees?

MR. STEIN: No. No. Accepted for consideration. Now, the one report that I do think--I think we have two reports that we can move forward from. One is that Monitoring Committee report, if they will continue, and I am not asking you to adopt the full report, but I think the monitoring group can go on, use that as a basis with your recommendation to do its monitoring and come back with other information.

I think the pesticide group has laid out the problem and with the other aspect of the problem that I indicated, what materials are being used in the insecticide problem, if you want to narrow it to that, what materials are being used and where they are being used, and set up a program for monitoring some streams and see if we can get a cleanup. I am not at all sure that we are that far ahead on the other reports.

As far as nuclear power and thermal discharges, I think we will have to ask Mr. Poston to take the lead and the States come up with a committee to make specific recommendations of where we go on that.

On agriculture and cattle feed lots, I think we are going to need a specific recommendation of where we go on that if anywhere.

Now, I think that covers it all. I think we have pretty well done a very good job as far as the States can go on watercraft, and, of course, there is Federal legislation pending. The research, of course, we will hear from,from time to time, but I think that has to just continue. You probably knew this was a long-range program and I think this about covers all the items here.

What I do think is that this has indicated that we are really moving very well with these programs. I suggest we probably have a sense of euphoria--we are in the first blush of the program and the defects and the laggards haven't shown up yet. But there are none apparent now. It is also apparent that at the first go-round we haven't quite got our fingers on the nuclear problem or thermal discharge problem yet, whether we will ever get our fingers on it; we don't quite have it on the agricultural problem yet; we are pretty much moving ahead with a solid program on monitoring; and we are at least in the batter's box on the pesticide program and we may go out to get specific results.

And we are well down the road, we are heading around the bases on our big problem, and that is industrial and municipal wastes, discharge treatment, chlorination of the effluent and phosphorus removal, and this is a great thing.

Are there any other comments or questions?

Yes, Mr. Purdy.

MR. PURDY: On the Pesticides and Monitoring Committee reports, I think that they are in good shape to be adopted and that the particular surveillance recommendations made are programs that we should attempt to implement.

MR. STEIN: Right.

MR. PURDY: However, say to implement them to the last as presented in the report, I don't think that we can commit ourselves to that.

MR. STEIN: That is precisely why I held this back and made this kind of distinction. I think we can move ahead on the monitoring and pesticide report, but I think obviously before you would want to commit yourself to every word of that report you would need a lot more time, and to get the program necessary I don't know that that is really necessary.

MR. PURDY: In many instances I think that all of the States have moved forward--

MR. STEIN: Right.

MR. PURDY: --and are accomplishing much

of the monitoring recommended.

MR. STEIN: I agree with that.

Are we set? Are there any other comments?

MR. POSTON: You indicated that we had moved along on phosphate removal and chlorination, and I wondered, is there complete agreement that all municipal treatment plants will provide chlorination regardless of whether they are a stabilization pond or package plant or what-have-you regardless of size? It is my understanding that that was, but I wanted to kind of clarify it.

MR. STEIN: Do we have the recommendations of the Conferees? Where was the first Conference record? Didn't we recommend chlorination?

MR. LELAND: Across-the-board.

MR. STEIN: That is what I thought. I didn't know that was an issue.

MR. POSTON: I don't know that it is, but I thought I would get a clarification--

MR. STEIN: All right. If that is an issue, let's hear about it, but I thought that was a recommendation.

MR. FRANGOS: Mr. Chairman, it is my

recollection that there was some question about this at the last Conference as it related to lagoons.

MR. LELAND: No. 4, Murray.

MR. PURDY: Mr. Chairman, in that particular case I think I should clarify our report that our lagoons in Michigan are not flow-through lagoons, they are storage lagoons discharged twice a year, long detention times, and testing has shown fairly low coliform counts in the effluent when they are discharged in the spring and fall and that we have not at this point in time required chlorination of the lagoons where we can operate them on a fill and draw basis.

MR. STEIN: Here is what it says, and if there is any problem on that let's--maybe this should be taken on a case-by-case basis. This looks like we are scrambling for inches here, but what it says is:

> "Continuous disinfection is to be provided throughout the year for all municipal waste treatment plant effluents."

Now, I think if there are specific plants that you feel this applies to that the requirement is not being met, I think we should begin dealing with specifics on this rather than act. I can see where there is some leeway on this if a--and we heard some statements made, for example, by Mr. Frangos, of having holding lagoons for stormwater or something of that kind in a treatment plant. You may want to run some of that through the treatment plant when you can, at other places you don't, and is that a plant effluent just because it goes through the lagoon and the stormwater comes out. If FWPCA or your field crew have any specific plants where you feel that this 4 is not being applied, let's have a report on them if you can't resolve it and take it up one at a time.

MR. POSTON: I had no particular one in mind.

MR. STEIN: Right. But I don't know; we may be making a problem where none exists.

Are there any other comments or questions?

If not, I thank you all for coming. The hotel now has five minutes to set this up for their dinner. We thank them very much and we stand adjourned.

(Whereupon, at 6 o'clock p.m., the Conference was adjourned.)

(Permission was given to submit for the record the following appended documents.)

March 14, 1969

Your Reference: ALFDG-EN

Commanding General
Headquarters Fifth U.S. Army
Fort Sheridan, Illinois 60037

Dear Sir:

This is in reply to a letter from Major Gerald Kroll, dated March 12, 1969, pertaining to a status report prepared by Colonel [illegible] B. Warner on potential Lake Michigan pollution sources under the jurisdiction of Headquarters Fifth U.S. Army, and presented at the Lake Michigan Enforcement Conference in Chicago, Illinois on February 25, 1969.

We would like to make two additions to Colonel Warner's report, as follows:

a) To include the identification of the two NIKE sites, No. 46 which has been closed, and No. 45 which has been reduced to administrative type functions.

b) To include a projected completion date of June 30, 1969 for the sewer connection for conveying the steam plant blowdown water to the sanitary sewer system and thence to the sewage treatment plant.

If you concur with the above suggested additions, the amended status report will be included in the transcript of proceedings of the reconvened conference.

Your cooperation in this matter is appreciated.

Sincerely yours,

H. W. Poston
Regional Director

DEPARTMENT OF THE ARMY
HEADQUARTERS FIFTH UNITED STATES ARMY
FORT SHERIDAN, ILLINOIS 60037

ALFGD-EU

25 MAR 1969

Mr. H. W. Poston
Regional Director
Federal Water Pollution Control Admin.
33 East Congress Parkway, Room 410
Chicago, Illinois 60605

Dear Mr. Poston:

In reply to your letter of March 14, 1969, we advise that Headquarters Fifth US Army concurs with additions a) and b) as shown.

Sincerely yours,

D. B. Roberts
D. B. ROBERTS
1LT, AGC
Asst Adjutant General

DEPARTMENT OF THE ARMY
HEADQUARTERS FIFTH UNITED STATES ARMY
FORT SHERIDAN, ILLINOIS 60037

12 MAR 1969

ALFGD-EU

Conferees in the Matter of Pollution
of Lake Michigan and its Tributary Basin
ATTN: Mr. H. W. Poston, Regional Director
Federal Water Pollution Control Administration
33 East Congress Parkway, Room 410
Chicago, Illinois 60605

Gentlemen:

In accordance with a request from Mr. H. W. Poston, the Federal Conferee, dated February 11, 1969, Colonel E. B. Warner, Chief, Engineer Division, Headquarters Fifth US Army, prepared a status report on potential Lake Michigan pollution sources within your interest and under the jurisdiction of Headquarters Fifth US Army.

At the reconvened conference on February 25, 1969, it was determined that a formal statement was not applicable and Colonel Warner's report was provided extemporaneously. Consequently, Headquarters Fifth US Army has been requested to provide a written version of his report.

The progress report on the four potential pollution sources under the jurisdiction of Headquarters Fifth US Army was as follows:

a. The waste from the four NIKE sites located within the State of Indiana is chlorinated. On December 11, 1968, the conferees of the conference on pollution of the interstate waters of Grand Calumet River, Little Calumet River, Calumet River, Wolf Lake, and Lake Michigan and its tributaries were advised by the Federal Water Pollution Control Administration that all four of those NIKE sites were in compliance with the recommendations of those conferees. Headquarters Fifth US Army has thus concluded that these NIKE sites are also in compliance with the recommendations of this conference and no further improvement is planned. In the interim, one of the NIKE site areas has been closed, and the activities at another have been reduced to merely administrative type functions. Full-time population does not exceed 100 persons.

b. Fort Sheridan steam plant blow-down water will be treated by discharging same to the Fort Sheridan Sewage Treatment Plant. The approximate 30 feet of connecting sewer will be installed by in-house forces, using local funds already available, as soon as the ground thaws.

c. The Fort Sheridan Water Treatment Plant is undergoing a rehabilitation and construction program. The repair portion is being accomplished with funds and approval available to Fort Sheridan and is currently underway. The construction portion includes facilities for treating the backwash water. Unfortunately, the construction portion can only be accomplished with funding and approval of the United States Congress. This project is currently included in the fiscal year 1971 Military Construction Program. It was originally programmed for funding in fiscal year 1970, but the project was deferred to fiscal year 1971 by the Department of Defense. Assuming that the funds are authorized as currently programmed, the earliest possible date Fort Sheridan will be in compliance with the conference recommendations on backwash water will be approximately one year beyond the date set by this conference.

d. Nutrient removal for the Fort Sheridan sewage effluent will be provided by discontinuing the sewage treatment plant operation and diverting the sewage to the North Shore Sanitary District. This approach also requires Congressional approval and the necessary project was included in the fiscal year 1970 Military Construction Army Program but was deferred by higher headquarters to the fiscal year 1971 Program. If Congressional approval and funding is provided as currently scheduled, the required December 1972 completion date relative to treatment for phosphate removal can be met.

Following the verbal presentation, the conferees asked Colonel Warner if the Fort Sheridan effluent was chlorinated and they were advised affirmatively. The conferees also asked if Fort Sheridan had a commitment from the NSSD to accept the sewage. The conferees were advised that a commitment had been obtained from the MSSD several years ago and that this commitment was now in the process of being updated.

Sincerely yours,

[illegible]
MAJ, AGC
Asst Adjutant General

Copy furnished:
CO, Ft Sheridan, Illinois 60037

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